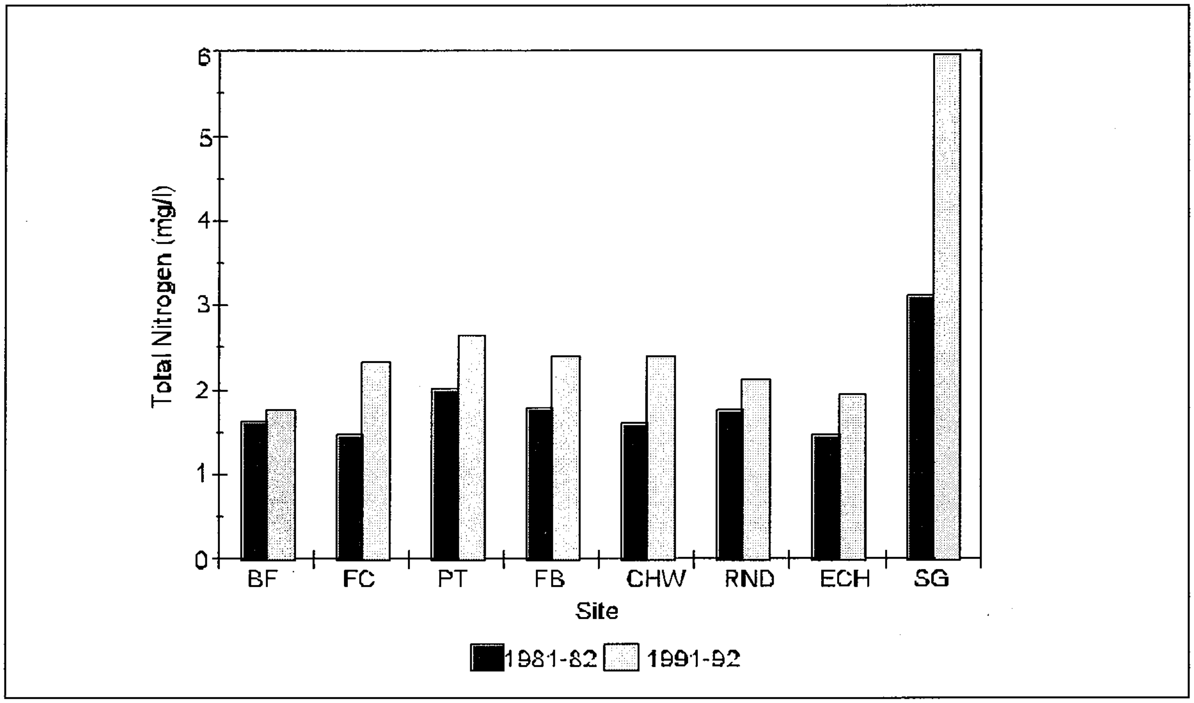

Figure 4. Comparison of Total Nitrogen Concentrations Between Time Periods.

There was no consistent increase or decrease in TP values among the sites. The most important observation to make is these values are all very high.

Of all the data, the increases in Flint Creek and the Baron Fork are probably the most alarming (**Figure 5**). The values from the samples collected the first year at Flint Creek were uniformly low and often below the detection limit of 0.005 mg/L. These values began to rise during 1982 but the two-year average is still quite low compared to other sites. The 91-92 values from this site are much higher and indicate a real change in phosphorus concentrations over the study period. A similar situation occurred in the Baron Fork. Seventeen of the first twenty-four samples collected contained phosphorus concentrations below the detection limit. The 91-92 values are greatly increased indicating a definite change in water quality in this river.

The concentration of TSS has not changed much over the study period with a fairly uniform distribution of increases and decreases. The values are similar down the course of the river with the exception of Camp Paddle Trails which is much higher than other sites. This is probably due to the dislodging of sediments from Lake Frances.

There has been a great deal of discussion concerning the loss of clarity in the river. From the data above it cannot be concluded that any observable changes have occurred between 1980 and 1992 (**Figure 6**). Drinking water is allowed a turbidity of

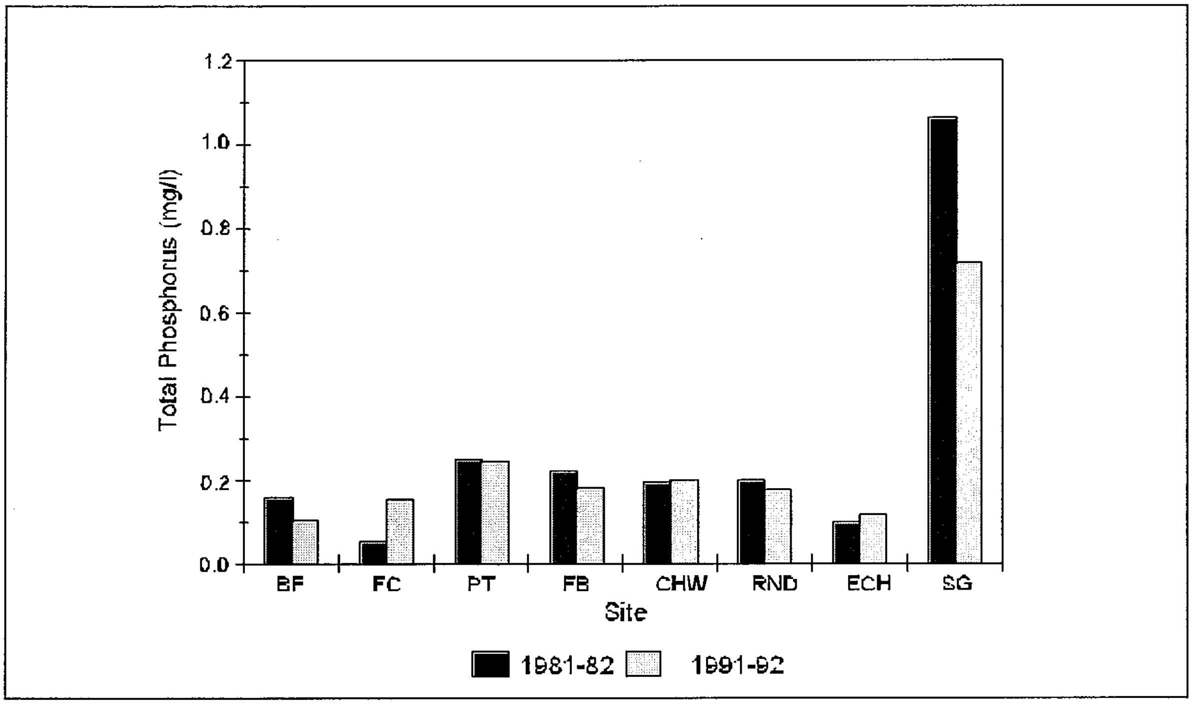

Figure 5. Phosphorus Concentration Comparison Between Time Periods.

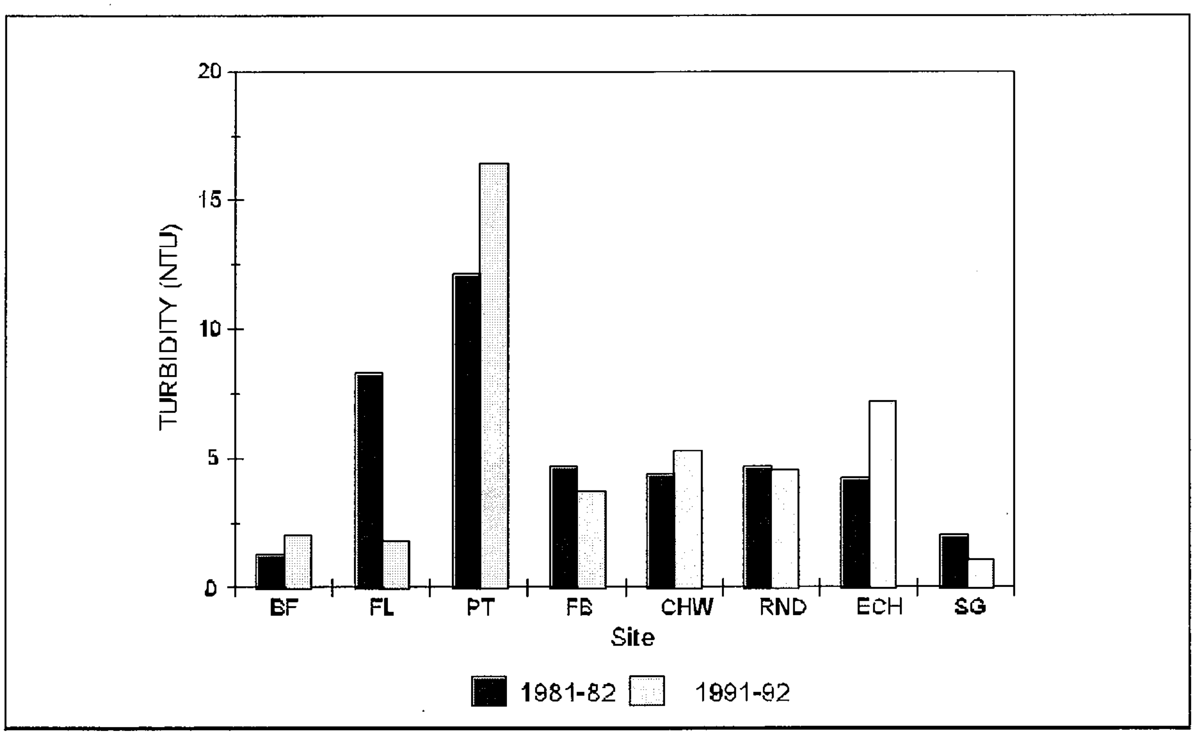

Figure 6. Turbidity Comparisons Between Time Periods.

1.0 NTU; therefore, since most of the changes are around this level, it is doubtful that observable (human eye) changes have occurred.

With such a large percentage of county residences relying on private water supply, the potential adverse affects of ground water contamination are readily apparent.

D. WATER QUALITY IN SMALL STREAMS OF THE ILLINOIS RIVER BASIN

Sixty-two small streams in the Illinois River watershed were monitored during 1990-1992 to determine the extent of nonpoint source (NPS) pollution occurring from land uses in small watersheds and to rank the watersheds as part of the BMP implementation process.

Streams were monitored on a quarterly basis under baseflow conditions and twice per year during runoff events. The data from these collections are summarized in **Table 12**.

Table 12. Summary of Water Quality in Illinois River Tributaries.

	TN (bf) (mg/L)	TP (bf) (mg/L)	TN/TP (bf) (%)	TN (re) (mg/L)	TP (re) (mg/L)	TN (re/bf) (%)	TP (re/bf) (%)
Minimum	0.18	0.001	8.51	0.24	0.004	0.41	0.31
Maximum	6.40	0.752	660	6.63	0.731	3.39	32.00
Mean	1.48	0.041	79	1.74	0.058	1.23	1.93*
TN = Total Nitrogen; TP = Total Phosphorus; bf = baseflow; re = runoff event * = maximum value omitted (value = 2.41 with outlier)							

It is generally agreed that nutrient loading in the Illinois River Basin is the major source of concern for both current conditions and long-term trends. Unfortunately, Oklahoma has no numerical standards for nitrogen or phosphorus. Guidelines exist in the literature but vary by author. Since the selection of a single guideline number would be somewhat subjective, it is probably best to discuss the data in terms of the range of opinion that exist in the literature.

Before the importance of nutrients at individual sites is discussed, it may be helpful to focus the discussion on the nutrient of greatest concern. The third column of data in the above table concerns the ratio of nitrogen to phosphorus found during baseflow conditions. This ratio is important in understanding the ability of the water to support algal growth and for management purposes as the addition of a limiting nutrient would accelerate algal growth. There is some range of opinion concerning the N:P ratio at which one or the other element becomes the factor responsible for limiting algal growth. The majority of research indicates that at N:P ratios of less than 10-16, nitrogen is the limiting nutrient, while phosphorus becomes limiting at higher ratios.

From column 3 it can be seen that the average N:P ratio is much greater than 16. In only 4 of 64 streams was the N:P ratio less than 16, and only one was less than 10. From these data it can be inferred that, as a basin-wide phenomenon, phosphorus availability is much more important in determining levels of algal growth than nitrogen; therefore, the discussion of nutrient levels will focus on phosphorus. It can also be inferred from this ratio and the high average nitrogen value that adequate nitrogen exists in these streams to support luxuriant algal growth. It should be noted that the factors concerning algal growth are much more complex than mere N:P ratios in that a number of micro-nutrient as well as physical factors are involved; however, N and P levels are often the controlling factors.

As previously mentioned, the maximum recommended level of phosphorus varies by author. In addition, the recommended level will also depend upon the nature of the receiving as well as downstream waters. It has been suggested that stream levels as high as 0.050 mg/L will cause no harm in the stream, although some authors put this value as low as 0.020 mg/L. The lower values are recommended when a downstream loading is a problem as occurs when a river is impounded. For the streams sampled in the Illinois River Basin it can be seen that, on average, baseflow phosphorus values approach the upper end of this range. Phosphorus values are distributed as follows:

Range (mg/L)	# of stream segments
<0.005 - <0.020	31
0.020 - <0.050	20
≥0.050	13

From these data it can be concluded that phosphorus is adequate to support rich algal growth in many streams of the Illinois River Basin, although it is inadequate in concentration relative to the amount of nitrogen present. This conclusion may seem somewhat contradictory as it suggests that phosphorus is both plentiful yet limiting. This type of contradictory evidence supports an assertion that algal productivity is closely tied to the abundance of some other nutrient. The identity of this nutrient is as yet unknown.

Historically, most attention has been placed on phosphorus limitation and as a result of this focus there is relatively little information suggesting maximum recommendations for nitrogen. A generally accepted upper limit for nitrogen for preventing the development of eutrophic conditions is 1.0 mg/L. The mean total nitrogen for all stream segments tested was 1.48 mg/L with the values being distributed as follows:

Range (mg/L)	# of stream segments
0.18 - 0.89	23
0.90 - 2.00	21
≥2.00	20

These data indicate that approximately two-thirds of the streams in the basin have nitrogen values which could result in eutrophic conditions. With twenty streams having values greater than 2.00 mg/L, it seems apparent that nitrogen levels are high enough to be a cause of concern for stream quality as well as downstream loading. These data also support the conclusion that nitrogen is not a limiting factor for algal growth.

It is also important to look at this data in terms of the relative concentration of nutrients under baseflow versus runoff conditions. As can be seen in the last two columns of **Table 12**, both nitrogen and phosphorus were elevated in runoff conditions. In some cases this was extreme while in others stream water appears to have been diluted. However, on average, nitrogen concentration increased approximately 23% while phosphorus increased 93%. Given the increased discharge during runoff events and the fact that the values gathered probably do not represent maximum event concentrations, it can be concluded that runoff of nutrients is an important contributor to stream and subsequently river water quality.

CONCLUSIONS

The primary conclusion that can be drawn from these data and comparing them to historical data is that water quality in the Illinois River was essentially similar between 91-92 and 81-92. There have been some changes, both positive and negative; however, for the most part these have been minor. The biggest changes that can be seen are in the degradation of water quality in Flint Creek and the Baron Fork.

A significant quantity of the nutrients in the river are coming from across the Arkansas border; however, significant contributions are occurring within Oklahoma. From the data it is obvious that sewage treatment plant discharges pose a major threat to river quality, although it should be mentioned that is difficult to assess the magnitude of this contribution relative to that from non-point sources based on these data. Contributions of nutrients within Oklahoma between Fiddlers Bend and Tahlequah must be almost entirely nonpoint source in nature.

A particular area of concern must be the contribution of nutrients and sediment from Lake Frances. Given the structural conditions which now exist, it is possible that almost all of the accumulated lake sediment will eventually be discharged into the river as it meanders across the lake bed unless corrective measures are taken.

Given the levels of nutrients in the river, it is not surprising that Lake Tenkiller is experiencing nutrient problems as demonstrated by accelerated eutrophication. The lake will continue to degrade at a rapid rate until these nutrient levels are significantly reduced.

One other area of concern is contamination of ground water from disposal of human and animal wastes. As will be illustrated in other sections of this document, rates of land disposal within the basin area very high. County residents rely on groundwater as their domestic supply as listed in **Table 13**.

Table 13. Housing Units and Residents with Private Water Supplies (Delaware, Cherokee, and Adair Counties).

County	Housing Units	Units w/ Private Supply	Residents w/ Private Supply (%)
Adair	7124	3477	8989 (48.8)
Cherokee	16808	8891	14849 (52.9)
Delaware	15935	4589	9500 (28.8)
Total	39867	16957	33338

E. ILLINOIS RIVER BASIN-- TREATMENT PRIORITIZATION FINAL REPORT

The OCC contracted with Oklahoma State University to use more sophisticated methods such as geographical information systems analysis to coordinate different types of data and prioritize subwatersheds in the Illinois River Basin (Sabbah et al. 1995). This report was an attempt to more closely coordinate land use and water quality information. The effort used the SIMPLE (Spatially Integrated Models for Phosphorus Loading and Erosion) modeling system developed by OSU to estimate watershed-level sediment and phosphorus loading to surface water bodies.

A section of the report dealt with identification and rank of potential phosphorus and sediment sources in the Peacheater Creek and Battle Branch Creek watersheds. Data layers were assembled including a digital elevation model, soil data, and current land use information assembled by the Oklahoma Cooperative Extension Service. Historical rainfall records (1950-1989) were used to run 40 one-year simulations. Long-term averages of runoff, sediment, and phosphorus loadings were estimated for each field and used to predict fields with high environmental risk potentials.

Average annual sediment loading from fields in the Battle Branch Watershed ranged from 0.00 - 0.88 Mg/ha (**Figure 7**). Predicted sediment loading was highest along the stream channel and from pasture, cropland, and hay meadows as opposed to woodlands.

Average annual total phosphorus loading to the stream ranged from 0 kg/ha - 9.34 kg/ha (**Figure 8**). Highest loadings came from fields with high soil test phosphorus levels and from cropped fields, pastures and hay meadows. Highest loadings were also seen in the headwaters of the watershed, as opposed to lower in the watershed, suggesting BMP implementation should focus on headwater areas, and then move downstream.

Average annual sediment loading from fields to Peacheater Creek ranged 0.00 - 0.96 kg/ha (**Figure 9**). Again, predicted sediment loading was highest along stream channels and from hay meadows and cropland.

Average annual total phosphorus loading to the stream in Peacheater Creek ranged from 0.01 - 34.88 kg/ha (**Figure 10**). Highest loadings came from hay and pasture land and were associated with high soil phosphorus levels. These high soil P levels likely result from application of poultry litter and perhaps from pasturing cattle. Again, areas providing the highest phosphorus loading are concentrated in the headwaters. This suggests BMP implementation should focus in headwaters before downstream areas.

Two critical ideas are supported by this report. The first is that much of the soil erosion in these watersheds happens along stream courses, and is probably associated with stream bank erosion. The second is that much of the phosphorus comes from the headwaters of the watershed, thus remediation efforts should concentrate in this area.

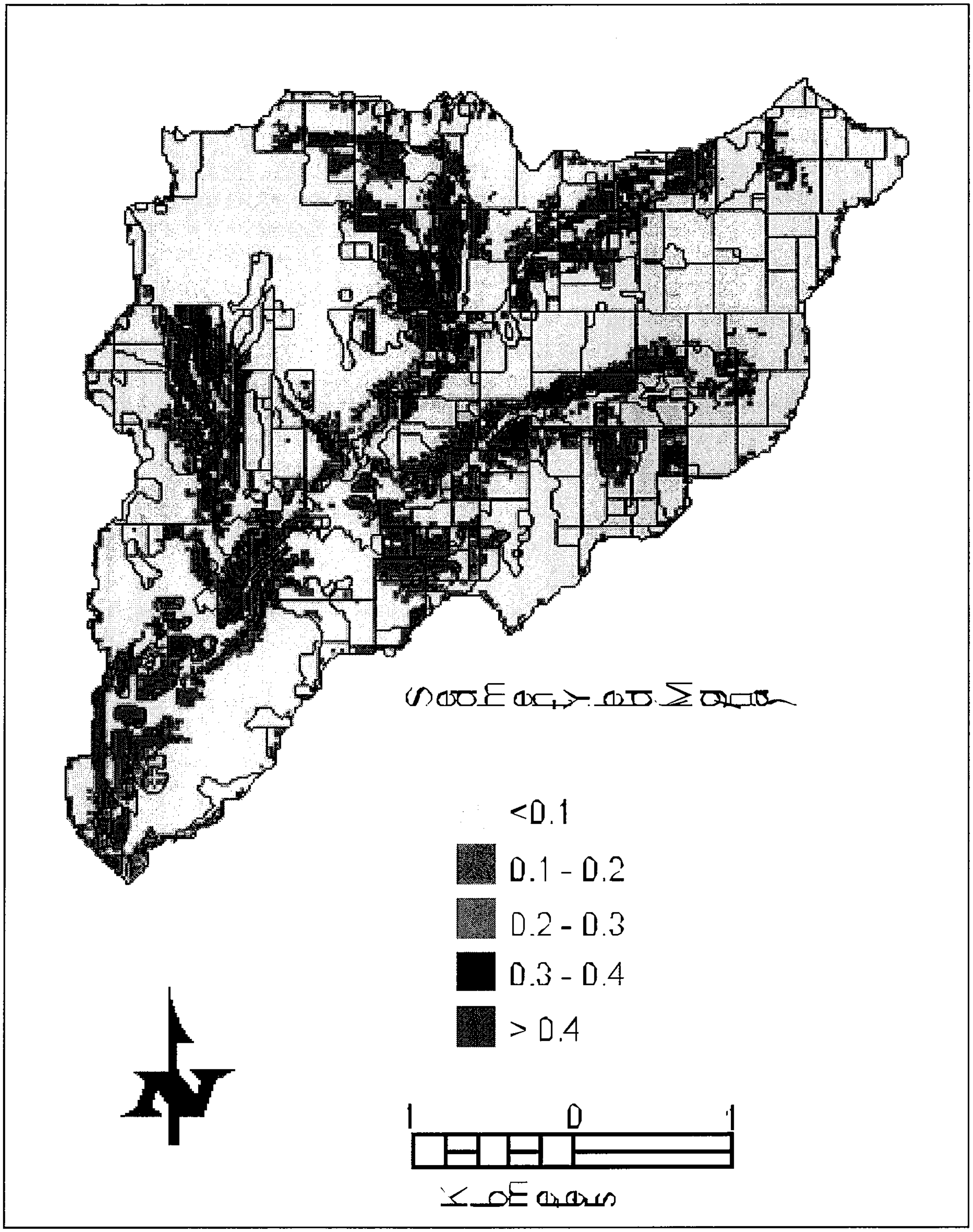

Figure 7. Average Annual Sediment Loading to Battle Branch Creek Predicted by SIMPLE.

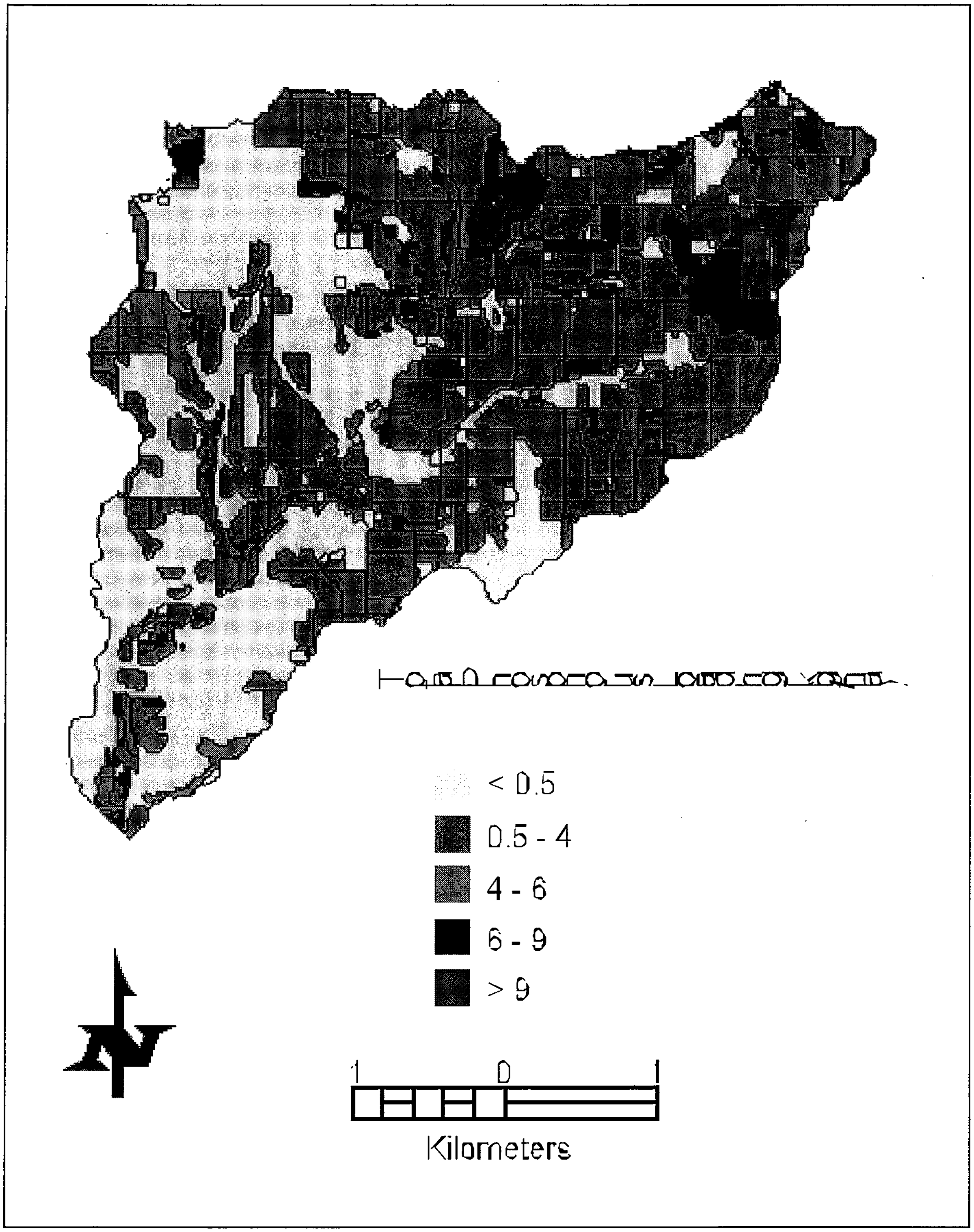

Figure 8. Average Annual Total Phosphorus Loading to Battle Branch Creek Predicted by SIMPLE.

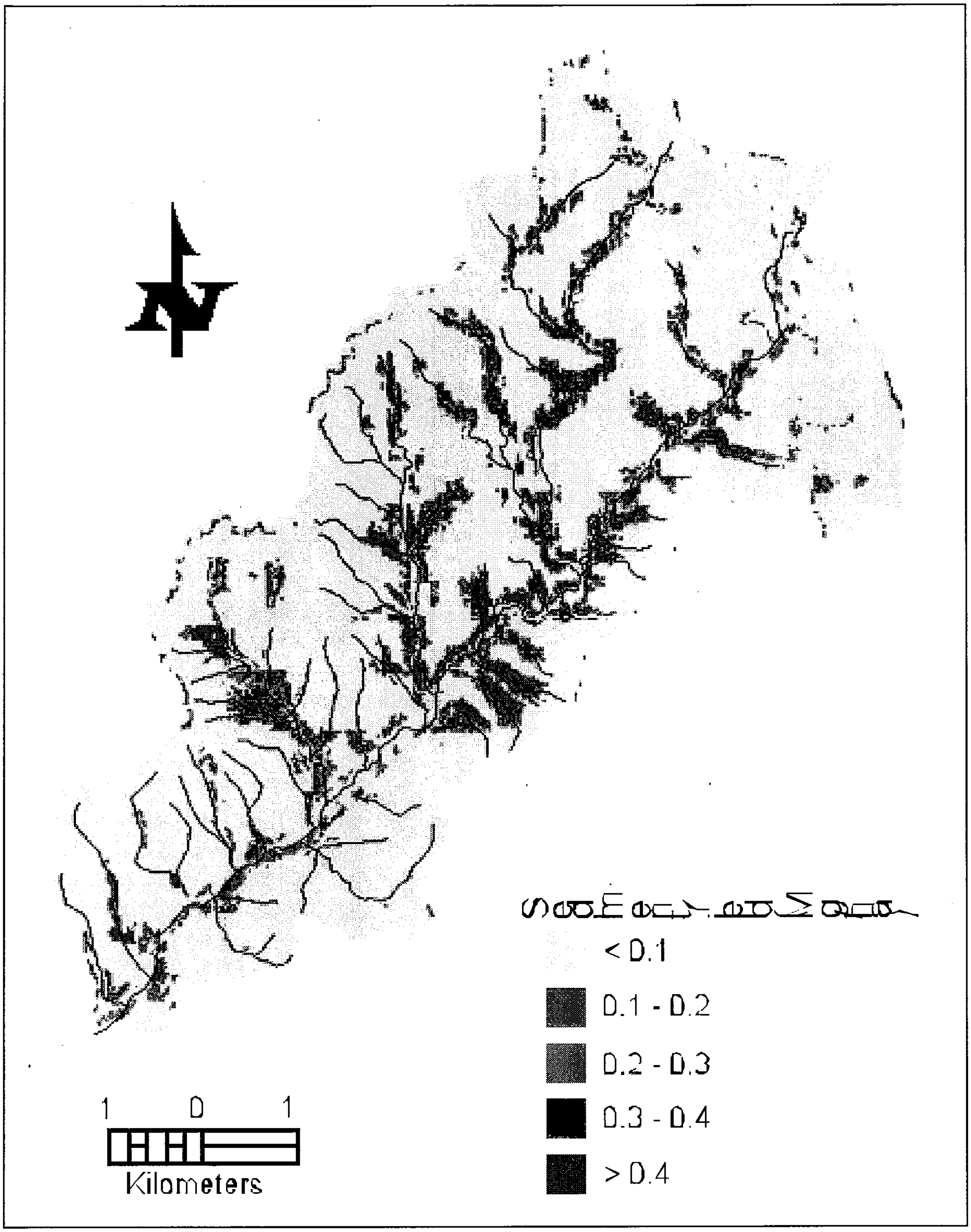

Figure 9. Average Annual Sediment Loading to Peacheater Creek Estimated by SIMPLE.

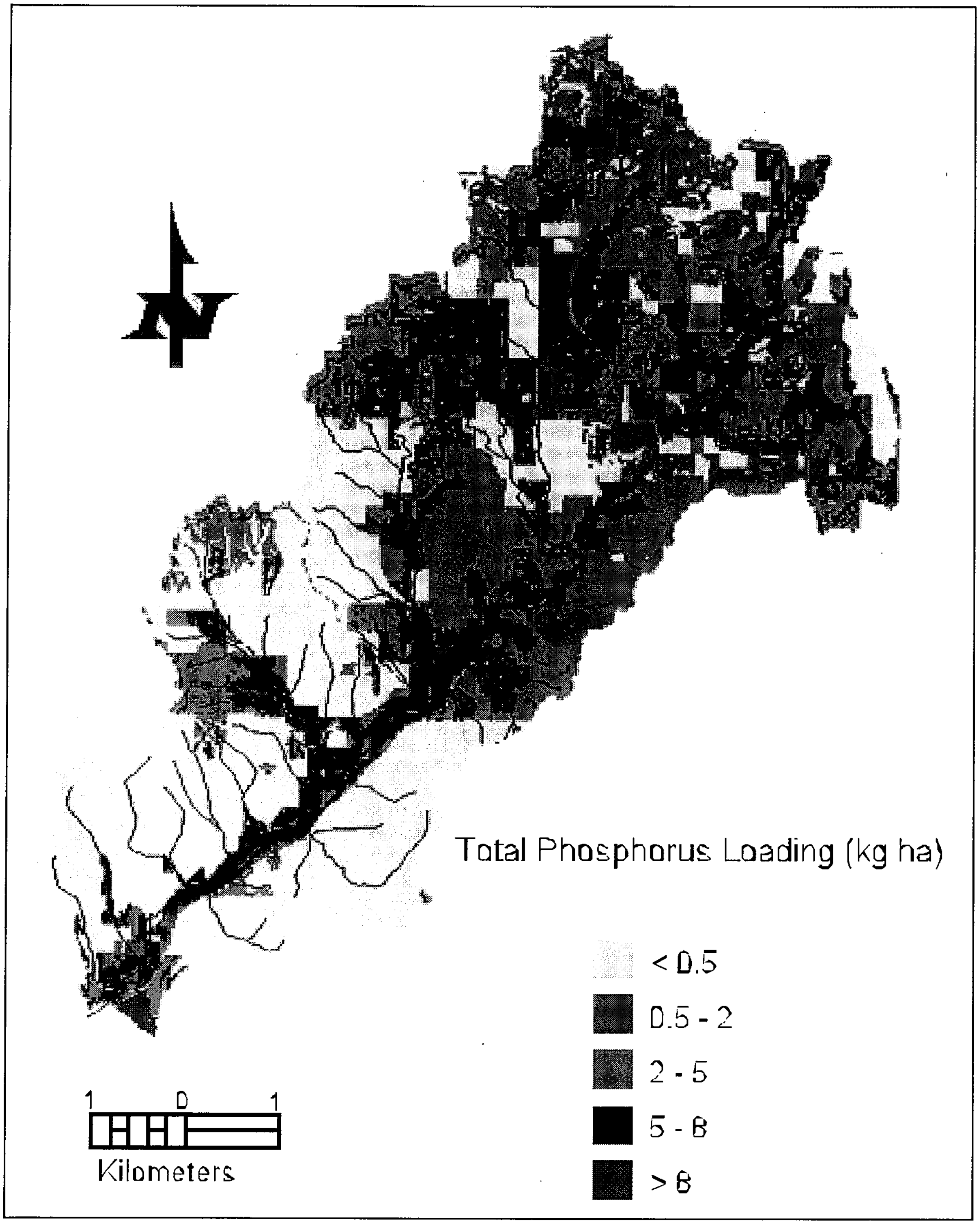

Figure 10. Average Annual Total Phosphorus Loading to Peacheater Creek Estimated by SIMPLE.

F. CLEAN LAKES PHASE I DIAGNOSTIC AND FEASIBILITY STUDY OF LAKE TENKILLER

The OWRB contracted with Oklahoma State University Water Quality Research Laboratory (OSU WQRL) to conduct an EPA Phase I Clean Lakes Study on Lake Tenkiller to diagnose the problems and recommend solutions. OSU WQRL studied the lake intensively between April 1992 and October 1993. Samples were collected at eight stations in and below the lake (**Figure 11**). Water Quality in the Illinois River and its tributaries was also analyzed for purposes of the study.

The study determined that water quality in Lake Tenkiller is currently showing signs of degradation. Symptoms included periodic algae blooms, excessive algal growth, and extensive hypolimnetic anoxia throughout stratified periods. The lake was classified as eutrophic based on nitrogen, phosphorus, and chlorophyll *a* concentrations (**Table 14**) which were excessive when compared to published criteria. These loads were predominantly derived from nonpoint sources during high flows and both point and nonpoint sources during low flows. These nutrient loads, especially the nonpoint fractions, have increased significantly since 1974 but have stabilized since 1985-86.

The study estimated the total nutrient loading to the lake, and partitioned that estimate by source. These estimates are seen in **Table 15**. These estimates represent loading to the lake from both Oklahoma and Arkansas. Distribution of the loading suggests the majority of the nutrient load is from nonpoint sources, although point sources contribute significant amounts. Analysis of the loading estimates also suggests the majority of loading is associated with highflow events. These conclusions are critical to the development of pollution reduction plans in the basin.

The excessive nutrient loads have increased algal growth and thus compromised water clarity throughout the lake and its tributaries. Nutrient limitation analysis indicated that the lake was phosphorus limited in the lower end (near the dam), variably limited (both phosphorus, nitrogen, and light) in the midreaches, and probably light limited in the headwaters. Based on these results, it was concluded that source control of phosphorus loading was the optimum management alternative. Accumulation of toxics in the lake water and sediments and resident fish did not appear to be a problem.

The study listed three alternative phosphorus control options and recommended initiation of a phosphorus control strategy in the basin. Those three options included:

1. No action.
2. Maintain current condition of the lake by preventing further increases in nutrient loads.
3. Reverse the accelerated eutrophication with more stringent phosphorus control measures.

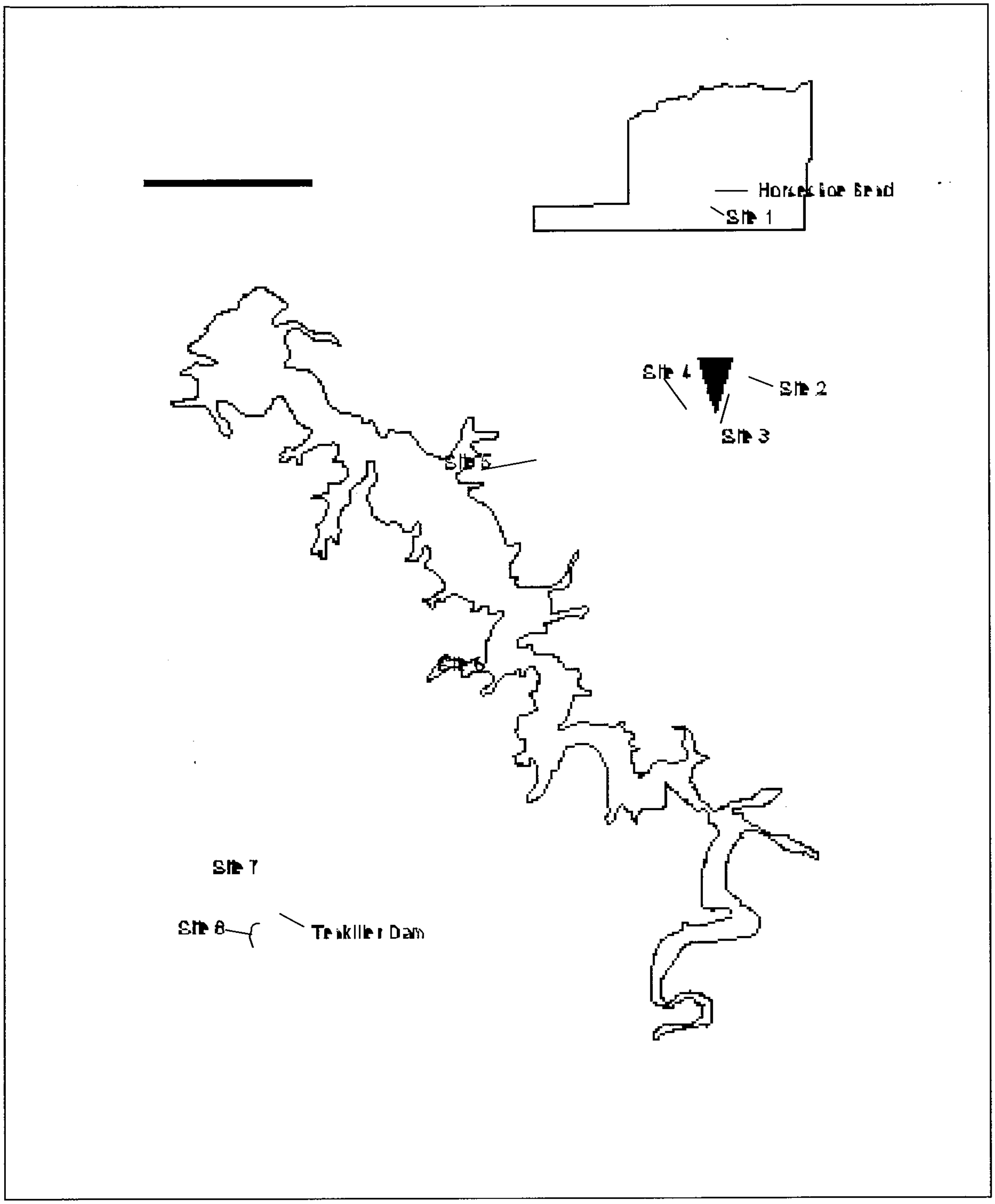

Figure 11. Clean Lakes Phase I Sampling Sites on Lake Tenkiller.

Table 14. Epilimnetic Nutrient Concentration Statistics of Lake Tenkiller.

PARAMETER	STATION	MEAN	MEDIAN	S	n
o-PHOSPHATE (mg/ℓ)	1	0.11	0.09	0.05	16
	2	0.05	0.04	0.03	18
	3	0.04	0.03	0.03	18
	4	0.04	0.03	0.03	18
	5	0.03	0.02	0.03	18
	6	0.02	0.01	0.02	18
	7	0.02	0.01	0.02	18
TOTAL PHOSPHORUS (mg/ℓ)	1	0.14	0.12	0.07	16
	2	0.08	0.08	0.03	18
	3	0.08	0.08	0.04	18
	4	0.08	0.07	0.04	18
	5	0.05	0.05	0.03	18
	6	0.04	0.02	0.04	18
	7	0.03	0.02	0.04	18
NITRATE (mg/ℓ)	1	1.27	1.18	0.56	16
	2	0.53	0.46	0.44	17
	3	0.49	0.36	0.45	18
	4	0.46	0.34	0.42	18
	5	0.38	0.21	0.38	18
	6	0.44	0.30	0.40	18
	7	0.47	0.30	0.36	18
TOTAL NITROGEN (mg/ℓ)	1	2.25	2.18	1.00	16
	2	1.45	1.16	0.75	17
	3	1.40	1.23	0.77	17
	4	1.34	1.17	0.66	17
	5	1.06	0.79	0.60	17
	6	0.97	0.74	0.59	17
	7	1.01	0.74	0.64	17

S = Standard Deviation; n = sample size

Table 15. Estimated Distribution of Nitrogen and Phosphorus Loads to Lake Tenkiller.

Source	Estimated Average Load at Horseshoe Bend kg/yr (%)		Estimated Low Flow Contribution at Horseshoe Bend kg/yr (%)		Estimated Medium Flow Contribution at Horseshoe Bend kg/yr (%)		Estimated High Flow Contribution at Horseshoe Bend kg/yr (%)	
	N	P	N	P	N	P	N	P
Background	550000 (23.9)	25000 (11.0)	35200 (22.8)	1600 (9.7)	208450 (23.9)	5225 (10.9)	306350 (24.0)	18175 (11.2)
Point Source	61605 (2.7)	12547 (5.5)	35793 (23.2)	7290 (44.1)	19406 (2.2)	3952 (8.2)	6407 (0.5)	1305 (0.8)
Nonpoint Source	1688980 (73.4)	190078 (83.5)	83345 (54.0)	7628 (46.2)	643869 (73.9)	38968 (80.9)	961795 (75.5)	143482 (88.0)
Total	**2300585**	**227625**	154338 (6.71)	16518 (7.26)	871725 (37.89)	48145 (21.15)	1274552 (55.40)	162962 (71.59)

The above three options are not discrete options but represent a continuum of management. After considering the feasibility and effectiveness of control measures, the report recommended a 30 - 40% reduction in headwater phosphorus loads be implemented as a short-term goal and a 70 - 80 % reduction as a long-term goal. Since both of these goals still indicated a significant risk of hypolimnetic anoxia, it was further recommended that re-aeration devices be installed in the tailrace to protect the downstream trout fishery.

The report recommended the following programs be initiated to attempt to reduce phosphorus contamination within the basin:

1. Voluntary switch to non-phosphate detergents by all lakeside residents and the cities of Tahlequah and Watts, OK and Rogers and Springdale, AK.
2. Implementation of best management practices upstream from Lake Tenkiller to minimize contributions of phosphorus in surface water runoff from agricultural fertilizer and waste and poultry litter applications.
3. Continue to work with point source dischargers, to the extent possible within the watershed, to minimize discharges of nutrients, including phosphorus
4. Establish a citizens monitoring group for basic water quality analysis and evaluation thus affording a more robust assessment of management effectiveness.

G. DETERMINING THE NUTRIENT STATUS OF THE UPPER ILLINOIS RIVER BASIN USING A LOTIC ECOSYSTEM TROPHIC STATE INDEX

The Clean Lakes Study determined that Lake Tenkiller was phosphorus limited at the lower end, variably limited by nitrogen, phosphorus, and light availability in the mid-reaches, and light limited at the upper end. However, it was unknown whether the Illinois River was limited by the same factors. One goal of this study was to determine which nutrients most often limit primary productivity in tributaries to the Illinois River.

The watersheds of three tributaries to the Illinois River were chosen based on availability of historical water quality data, similar land use, and similar size. These were Peacheater Creek, Tyner Creek, and Battle Creek. Although Battle Creek watershed was smaller than Peacheater and Tyner Creek watersheds, all had predominantly pasture and range land use (63 to 68 percent), and substantial forest cover (32 to 36 percent). The main difference in land uses among the three watersheds was the degree of anthropogenic activity.

The study used *in situ* nutrient limitation assays to estimate limiting nutrients in the three creeks. Six nutrient enrichment treatments were tested: 1. Nitrate - 5 ppm, 2. Phosphate - 5 ppm, 3.Nitrate and phosphate - 5 ppm, 4. Micronutrients - from Weber et al. (1989) at 200 times concentration, 5. Total nutrients, consisting of treatments 3 and 4, combined, and 6. Control- deionized water. Periphytometers were colonized in a run 0.3 m deep above a riffle for 14 days. Growth surfaces were protected from grazers with an aluminum screen. Assays were conducted in April and October 1995.

Results of the nutrient limitation assays are seen in **Table 16** and **Table 17**. Sample replicates numbers less than six indicate loss of samples. High flow events occurred in Battle Creek during both sampling periods, resulting in loss of replicates due to scouring. Comparisons of the treatment means was done using the Waller-Duncan K-ratio t test (α = 0.20). Results of t tests suggested that Battle Creek was phosphorus limited in the spring 1995 but limited by something other than nutrients during the fall, possibly light availability. Peacheater Creek appeared to be co-limited by nitrogen and phosphorus during both spring and fall sampling. Tyner Creek appeared to be limited by some factor other than nutrients during the spring and co-limited during the fall.

Conclusions of the report focus on the variable status of growth limiting factors in tributaries of the Illinois River. Clearly the creeks are impacted by nutrients, but also appear to be impacted by another factor, possibly light availability which would be affected by turbidity. The variability of growth limiting factors in these streams suggest they are primarily impacted by nonpoint source pollution. Nonpoint sources vary temporally as well as they do in substance and nature of pollution. A stream impacted by point sources would be expected to have a more consistent growth limiting factor between seasons. The findings of this report support conclusions of previous studies

Table 16. Chlorophyll *a* concentration for various treatments in Battle, Peacheater, and Tyner Creeks during the period of April 8 - 21, 1995.

Site	Treatment	Replicate Number	Mean Chl. *a* (μg/cm^{-2})	Standard Deviation (μg/cm^{-2})	Coefficient of Variation (%)
Battle Creek	N	5	1.16	0.64	60
	P	1	1.61	--	--
	N and P	5	1.67	0.60	36
	Micro-nutrients	5	0.48	0.76	160
	Total Nutrients	2	1.98	0.39	19
	Control	6	1.05	0.30	28
Peacheater Creek	N	6	1.05	0.42	40
	P	6	1.38	0.44	32
	N and P	6	1.61	0.72	45
	Micro-nutrients	6	0.35	0.10	28
	Total Nutrients	6	1.66	0.69	20
	Control	6	0.51	0.23	46
Tyner Creek	N	6	0.31	0.17	57
	P	6	0.20	0.08	42
	N and P	5	0.28	0.11	40
	Micro-nutrients	6	0.20	0.15	77
	Total Nutrients	6	0.33	0.10	29
	Control	6	0.21	0.14	65

that nutrients and sediment are problematic in the Illinois River Basin.

Table 17. Chlorophyll *a* concentration for various treatments in Battle, Peacheater, and Tyner Creeks during the period of September 20 - October 3, 1995.

Site	Treatment	Replicate Number	Mean Chl. *a* ($\mu g/cm^{-2}$)	Standard Deviation ($\mu g/cm^{-2}$)	Coefficient of Variation (%)
Battle Creek	N	4	0.33	0.05	17
	P	2	0.24	0.26	109
	N and P	4	0.63	0.36	56
	Micro-nutrients	2	0.21	0.09	42
	Total Nutrients	4	0.57	0.14	25
	Control	4	0.28	0.17	62
Peacheater Creek	N	6	0.55	0.18	33
	P	6	0.35	0.06	16
	N and P	6	0.55	0.55	49
	Micro-nutrients	6	0.23	0.23	24
	Total Nutrients	6	0.69	0.69	50
	Control	6	0.28	0.04	11
Tyner Creek	N	6	1.09	0.43	40
	P	6	1.06	0.20	19
	N and P	5	1.01	0.24	24
	Micro-nutrients	5	0.45	0.21	46
	Total Nutrients	6	0.98	0.40	41
	Control	6	0.55	0.19	35

H. ANALYSIS OF BANK EROSION ON THE ILLINOIS RIVER IN NORTHEAST OKLAHOMA

One source of increased turbidity in the Illinois River, its tributaries, and Lake Tenkiller and increased bedload in the Illinois River and its tributaries is believed to be streambank erosion. However, the magnitude of the contribution of streambank erosion had not been investigated until OSU and the OCC completed a survey of bank erosion on the Illinois River in 1996-1997. This project involved completion of several milestones:

1. Initial bank characterization, selection of banks for detailed study, and detailed characterization of selected banks were performed and reported in the Bank and Reach Characterization Report.
2. Long-term bank erosion was measured from aerial photographs and reported in the Aerial Photograph Erosion Analysis Report.
3. Short-term bank erosion was measured in the field at selected sites along the length of the river.

1. Initial Bank Characterization

In July 1996 193 bank segments along the length of the Illinois River from below Lake Frances dam to Horseshoe Bend on the upper portion of Lake Tenkiller were characterized. Data was generally collected only on eroding banks, however, several stable banks were characterized to provide a comparison. An effort was made to measure only significantly eroding banks, based on the area of bank erosion, generally exceeding 1000 ft^2. Data collected included length, height, angle, river position, location, material, vegetation type and percent cover, root depth and density, maximum water depth, bankfull depth, and percent flow in the near bank region under bankfull flow conditions. Banks were then grouped according to physical and vegetative conditions and hydrologic influence. At least one bank from each group (36 sites) was selected for detailed characterization. Selected sites were characterized with Rosgen Level III stream reach condition evaluation (Rosgen 1996). Twenty-three of the 36 sites were characterized as C4c-channels, 11 as C4, and 2 as F4. C4c and C4 channels are gravel dominated, slightly entrenched, gentle gradient, riffle/pool channels with high width/depth ratios. These channels, characterized by depositional features, are very susceptible to shifts in stability caused by flow changes and sediment delivery from the watershed. F4 channels have similar characteristics but are entrenched. Channel bars are common, and bank erosion rates may be high due to mass-wasting of the steep banks (Rosgen 1996).

2. Aerial Photograph Erosion Analysis

USDA-SCS 1:7920 scale aerial photographs taken in 1958, 1979, and 1991 were analyzed with a method modified from Brice (1982) to estimate long-term bank erosion. A complete set of aerial photographs for the Upper Illinois River was not available for 1958, thus measurements for the period between 1958 and 1979 were made on a smaller area than measurements for the period between 1979 and 1991. Analysis yielded information on the 193 initially characterized sites in addition to 28 other significant erosional / depositional areas (generally greater than 0.5 acres lost by erosion or gained by deposition). Measurements included maximum lateral erosion, lateral erosion and/or deposition, land surface area, and length. For the period between 1958 and 1979, maximum lateral erosion averaged 67 ft, lateral erosion averaged 37 ft or 1.7 ft/yr, and lateral deposition averaged 47 ft or 2.2 ft/yr. A total of 64 acres of land was eroded, and 78 acres was deposited. The length of eroding areas averaged 1014 ft, and the length of depositional areas averaged 999 ft. For the period from 1979 to 1991, maximum lateral erosion averaged 74 ft, lateral erosion averaged 41 ft or 3.6 ft/yr, and lateral deposition averaged 5 ft or 0.4 ft/yr. A total of 195 acres of land surface area was eroded and 13 acres was deposited. The length of eroding areas averaged 1131 ft. and the length of depositional areas averaged 665 ft.

The river width, measured at each 0.5 river mile from bank tracings indicates that the river is widening. Average river width for 1979 and 1991 was 175 ft and 206 ft, respectively. Dividing the river into three 21 mile sections indicates that the river width increases in the downstream direction. River width in the first 21 mile section averaged 147 ft in 1958, 158 ft in 1979, and 185 ft in 1991. For miles 21 to 42, average width increased from 169 ft in 1979 to 195 ft in 1991. Average width on the lower third of the river increased from 199 ft in 1979 to 239 ft in 1991. Overall, the Illinois River became an average of 18% wider between 1979 and 1991.

The impact of riparian vegetation was measured using long-term erosion data. Relationships tested included maximum lateral erosion rate for forested, grassed, and mixed sites, maximum lateral erosion rate for forested, grassed, and mixed sites given the site eroded between 1958 and 1991, and percent of grassed, forested, and mixed bank length that eroded or received deposition. Between 1979 and 1991, mean erosion was greater on grassed and mixed land than on forested land but not statistically significantly. From 1958 to 1979, mean values were significantly different between forested, grassed, and mixed sites. Although mean values were generally lowest on forested areas, data indicated that major erosion could occur on forested as well as grassed and mixed sites and minor erosion could occur on grassed and mixed vegetation sites as well as forested sites.

The lengths of erosional and depositional areas were compared to vegetation data to determine the percent of forested, grassed, and mixed vegetation area length that eroded or received deposition. In both time periods, grassed areas had the greatest percent length of erosion and deposition and forested areas had the least. Over the two comparison periods, grassed areas were almost twice as likely to experience detectable erosion than mixed vegetation areas and 3.5 times more than forested areas.

3. Field Measurement of Bank Erosion

Short-term streambank erosion was measured with bank pins and cross-section surveys from September 1996 to July 1997. Erosion was measured after major flow events (exceeded 9000 cfs at the Tahlequah gage station) in September 1996, twice in November 1996, and in February 1997. Erosion was measured for 33 and 29 sites (out of 36 sites) after the second and fourth major flow events, respectively. After the first and third events, only 11 and 18 sites were measured. Pins could not always be relocated after events, and thus no data could be reported at those sites. In addition, several pins were lost due to excessive bank erosion (greater than 4 ft or erosion which removed 4 ft pins from bank). When possible, distance measurements from bank surveys were used to measure erosion in these cases.

Cumulative erosion after the four major flow events averaged 4.5 ft and ranged from -0.03 to 26.5 ft. Erosion was also measured once after two at or near bankfull events that occurred in spring and summer 1997. Erosion from these two events from averaged 0.40 ft and ranged from 0.00 to 2.35 ft. This study was conducted during a wet year when streamflow volume and frequency of significant flow events exceeded normal conditions. The average flow was 1123 cfs from August 1, 1996 to July 31, 1997, representing a 20% increase from normal conditions and a 3.0 year return period. Flow events also occurred with greater or equal to a 2 year return period during the course of this sampling. Data from the surveys indicated that several sites experienced aggradation, ranging from moderate to major. Other sites experienced degradation, although to a lesser degree than the aggrading sites experienced aggradation.

The impact of riparian vegetation was evaluated on short-term erosion data. Cumulative erosion for 27 sites after four major flow events was compared to riparian vegetation data. Differences in bank erosion between forested, grassed, and mixed sites suggested mean erosion from grassed and mixed sites exceeded that of forested sites. However, large variability among the vegetation types caused none of the differences to be statistically significant. Substantial erosion occurred on some forested sites while little erosion occurred on some grassed sites.

Conclusion

One of the major sources of sediment in the Illinois River basin is likely streambank erosion. Much of the watershed is grassland or forested (92%). Although clearing of forested areas for pasture is increasing, this area still represents only a small portion of the watershed. Estimated inputs of sediment from bank erosion (3.5 million tons of material between 1979 and 1991) indicate this to be a significant, perhaps the major source, contributing to bedload in the river and sedimentation of Lake Tenkiller.

Long-term erosion analysis indicated that natural riparian forested vegetation was important in reducing and preventing bank erosion on the Illinois River. Grassed banks were 3.5 times more likely to erode than forested banks and almost twice as likely at mixed vegetation banks.

In addition, the river is changing to a wider, shallower, perhaps braided river. Data show that in addition to extensive bank erosion, the river has widened from an average of 175 ft in 1979 to 206 ft in 1991. The width to depth ratio in many reaches of the river is approaching or exceeding 40 (the Rosgen criteria for a braided channel). The sinuosity in many reaches is approaching or less than 1.2 (the Rosgen criteria for a braided channel). Many channel reaches show signs of aggradation. This behavior can follow a cycle of high sediment input (either from upland or bank erosion), increased in-channel deposition, and increased bank erosion.

DESCRIPTION OF POLLUTION SOURCES

A number of potential sources of pollution exist in the Oklahoma portion of the Illinois River watershed. These sources have been identified by water quality studies, land use surveys, and local citizens as potential sources. These sources can be categorized as follows:

A. Point Sources:

Stilwell A.D.A. (WWTF)
Tahlequah WWTF
Westville WWTF

B. Nonpoint Sources:

Recreation
Lake Frances
Agriculture
Animal Production Operations
Urban Runoff
Mining
Streambank Erosion
Other

C. Combined Sources:

Nurseries
Urban Runoff

A. POINT SOURCES

A great deal of focus has been placed on the effects of sewage treatment plant (STP) discharge into the river. This section will attempt to summarize the relative contribution of those facilities to river water quality problems.

The majority of residents in Adair, Cherokee, and Delaware counties do not rely on public sewage systems for the disposal of domestic wastes. Figures concerning the use of public and private sewage disposal for these three counties are contained in **Table 18** (U.S. Census Bureau Structural, Plumbing, and Equipment Characteristics: 1990).

Table 18. Use of municipal WWTF in the Illinois River Basin.

County	Population	Housing Units	% public sewer	# public sewer
Adair	18,421	7124	29.1	2073
Delaware	34,049	16808	19.8	3328
Cherokee	28,070	15935	37.8	10610
Total	80,540	39867		16011

Based upon the combination of 1990 county population figures and data from the SCS Agricultural Waste Management Field Handbook the yearly disposal of wastes from residences on public sewage systems can be calculated (**Table 18**).

Table 19. Characterization of Domestic Liquid Wastes Produced in the Illinois River Basin.

County	Waste (dry tons)	Nitrogen (lbs.)	Phosphorus (lbs.)
Adair	482	58258	5826
Cherokee	498	60396	6040
Delaware	1154	139793	13979
Total	2134	258477	25845

The Shell Branch of the Baron Fork is listed on the 1998 Oklahoma 303(d) list as impaired by organic enrichment and dissolved oxygen problems from sources including nonpoint sources, agriculture, and waste disposal. The town of Westville discharges to Shell Branch and has thus been identified as potentially partially responsible for the water quality problems. A TMDL is slated for this stream in 1998-1999 by the ODEQ.

1. POTENTIAL SOLUTIONS

There are a number of approaches for addressing the effects of waste water treatment plant (WWTF) discharges on river quality. These include but are not limited to:

1. Upgrade all facilities
2. Establish a moratorium on new hook-ups
3. Move the points of discharge to different basins
4. Do nothing

Discussion of Potential Solutions

1. Upgrading wastewater treatment plants to operate under best attainable technologies or best practicable technologies is one solution for improving river quality. Given current technology, it is technically feasible for most discharges to produce water near purity. Although this level of treatment for all parameters is not warranted, reduction of nutrient discharges to the lowest achievable level should be considered. For facilities with retention lagoons, upgrading may be as simple as increasing the size of the lagoon so that discharge is not necessary. Upgrading waste water treatment plants is a very expensive alternative.

2. One alternative for preventing further increases in discharges from WWTFs is to restrict loadings to the treatment plants. This can be accomplished by restricting or eliminating new wastewater hookups. This would be an unpopular option for a number of reasons as it would affect most economic sectors.

3. Moving plant discharges out of the Illinois River Basin would eliminate discharges altogether but would likely be a very expensive process. In addition to technical considerations, cost of transport, and the physical availability of alternative discharge locations, citizens in potential discharge areas might object to this practice.

4. The option of taking no action should be considered in weighing the costs of river improvement. It may be that available financial resources would be better directed towards other sources. The TMDL process should help determine the direction of the most cost-effective nutrient reduction strategy. Although this option might be popular with municipalities, it will be difficult to convince landowners to take action if municipalities do not.

2. RESPONSIBLE ENTITIES

Oklahoma Department of Environmental Quality
Local Municipalities
Indian Tribes
Private Industry

The Oklahoma Department of Environmental Quality has jurisdiction over point source dischargers and the NPDES permitting process. ODEQ is also responsible for the development of wasteload allocations for other point source dischargers. ODEQ cooperates with local municipalities and Indian tribes in the construction and operation of WWTFs.

3. STATE GOALS

1) Municipal Wastewater Improvements

Two point sources were recently eliminated by combining flows with the city of Tahlequah. Wastewater Treatment facilities at the Cherokee Nation and Sequoyah High School facilities no longer discharge to the river, but is now subject to tertiary treatment at the City of Tahlequah facility. In addition, the cannery at Stilwell is no longer in operation, thus eliminating a third discharge to the river. The city of Stillwell will soon be upgrading to tertiary treatment to comply with an upcoming 1 mg/l phosphorus limit in their discharge permit, similar to that of the city of Tahlequah.

2) Water Quality Modeling

The water quality modeling currently planned by ODEQ in the Illinois River Basin is to set a total maximum daily load (TMDL) for causes of water quality problems in the Illinois River as identified on the State's 303(d) List. These include organic enrichment/dissolved oxygen, flow alteration, metals, nutrients, and siltation. TMDL's will be estimated for pollutants which affect these parameters. These TMDL's will be completed in 1998-1999. As previously mentioned, TMDLs will be completed for Shell Branch of the Baron Fork in 1998-1999.

4. COSTS

The City of Tahlequah upgraded its WWTF to tertiary treatment or nutrient removal capability and began operation in late 1990-91. This upgrade cost approximately 1.5 million dollars, but significantly reduced total P concentrations in the effluent.

The cost of upgrading the Stilwell WWTF to advanced treatment capabilities would be approximately 1.2 million dollars.

The cost of upgrading the Westville WWTF to advanced treatment capabilities would be approximately 2.6 million dollars.

These upgrades are generally funded by loans provided by and payable to the Oklahoma Water Resources Board Revolving Fund Program. Upgrades are generally financed by rate hikes, municipal bonds, etc.

B. NONPOINT SOURCES

1. RECREATION

Recreation provides a considerable economic stimulus in the Illinois River Basin. It is largely because of the potential effects on recreation that water quality problems in the Illinois River has received so much attention. Although most of the attention has been focused on the effects of point and nonpoint sources on recreation, the effects of recreational activities themselves must be considered.

It is estimated that over 400,000 persons visit the river each year for recreation uses and many of those visitors enjoy the river through canoe trips. During peak periods approximately 2,400 canoes are rented per weekend. Unfortunately the physical amenities are not in place to provide this many visitors with adequate waste disposal. Until 1995, only two of the seventeen river access points were equipped with toilet facilities. There were no convenient toilet or trash collection facilities for canoers.

With this many canoers and a lack of toilet and trash facilities, the disposal of trash and human waste is an obvious problem. A trip down the river clearly reveals the trash problem as evidenced by aluminum cans, paper, and other goods lying along the banks. The disposal of sewage is less evident; however, the ultimate fate of this material is obvious.

a. POTENTIAL SOLUTIONS

1. Restrict number of river visitors
2. Restrict river access
3. Restrict river activities
4. Improve facilities
5. Education

<u>Discussion of Potential Solutions</u>

1. Reducing the number of river visitors would have a direct effect on improving water quality and the aesthetic qualities of the river and its corridor as less trash and human waste would be disposed of in and along the river. This would likely be an unpopular alternative to canoe operators and concessionaires.

2. This approach is directly tied to one discussed above as reducing access should

reduce the number of visitors. One benefit of this approach is that trash and waste collection facilities could be concentrated at remaining access points. In addition to the negative economic consequences, this approach might cause physical degradation of access areas due to the increased intensity of use.

3. A restriction on river activities could reduce the amount of trash and physical damage to the environment. Examples of activities which might be restricted include: use of disposable materials, alcohol consumption, and overnight camping. The economic effects of these restrictions are difficult to predict and it can be argued that each would have positive as well as negative effects.

4. Improving the number and quality of trash and waste collection facilities should cause a significant decrease in the amount of material illicitly disposed. Increasing the availability of facilities does not guarantee their use; therefore, this alternative would not appear to be the best way to ensure a reduction in recreation associated waste. On the other hand, the absence of facilities guarantees the adoption of other practices. This would appear be a popular alternative with the only downfall being the cost of construction and maintenance.

5. Educating the public concerning proper river use and the consequences of improper river management offers a promising avenue for establishing direct contact with those who might be most affected by river degradation. Although education might not have a significant effect on adults, the effects on younger people, who make up a large percentage of river visitors, might result in long-term changes in attitudes towards the environment.

b. RESPONSIBLE ENTITIES

Oklahoma Scenic Rivers Commission
Recreation Concessions

The Oklahoma Scenic Rivers Commission (OSRC) is responsible for the operation and maintenance of the recreational corridor along the river. As such, OSRC has the authority to implement rules and regulations concerning waste practices along the river. OSRC is also responsible for the construction and maintenance of river access and waste disposal facilities.

c. STATE GOALS

One of the goals of OSRC is to improve the number and quality of toilet facilities at river access points. OSRC has recently completed a project that bought land and developed a "canoer only" access area on the river (OSRC 1998). This area provides restroom, picnic, and trash disposal facilities which are accessible only from the river. The long term goal was the establishment of a minimum of 10 complete facilities. Funds have been provided to establish 10 - 12 restroom facilities easily accessible from the river. In addition, a contract has been signed to lease and maintain (twice daily clean out during peak season) portable facilities which goes into effect in 1999.

As part of the aforementioned project, OSRC purchased and placed informational signs at all access areas including one commercial canoe landing. These signs were placed where river users can see them from the water and identify the site and list various conveniences available to users. In addition, OSRC placed a sign at the entrance to the Illinois River on Highway 10 which promotes the OSRC's and Cherokee County Conservation District's Educational Illinois Jones Program. This program is directed at educating children in the watershed about the problems and potential solutions to problems in the Illinois River Watershed.

Funds from the OSRC project have also been used to purchase and continue a trash bag program, originally instituted under an FY 1991 319(h) Illinois River Program. Bags have been provided to each commercial floatation device operation and other businesses for distribution to river users. Commercial floatation device operators estimate that 60-80% of the bags distributed are used for litter. OSRC estimates average return of 5 lbs. of litter per bag, resulting in approximately 118 tons of litter being collected and removed as part of this program.

OSRC is considering the option of limiting canoer numbers through a voluntary program with canoe operators. Other considerations for the future include banning the consumption of alcoholic beverages on the river.

d. COSTS

Purchase of land and construction of pit toilets and facilities at the canoer-only access point cost approximately $40,000. It is estimated that the installation of pit toilets at the ten facilities would cost $100,000. Improved toilet facilities would cost approximately $600,000. Trash disposal from river access points costs $40,000 to $50,000 yearly not considering labor. Future plans call for the use of portable toilet facilities at access points where permanent facilities are impractical. These would cost approximately $50,000 with annual operating costs of $10,000 to $20,000. It is estimated that stream bank stabilization in critical areas under the jurisdiction of OSRC would cost $200,000. The current operating budget for the Oklahoma Scenic Rivers Commission (OSRC) is $337,000.

Although the long range goal of the OSRC is to install permanent facilities and purchase more land for access areas, the current contract to provide clean portable facilities should be sufficient to meet the needs of river users for the foreseeable future. Almost as important as the provision of the facilities are the education programs which emphasize to users why it is important for them to make the effort to use the facilities provided. Both the OSRC and the Cherokee County Conservation District have education programs which focus on that aspect and others pertaining to protecting the water resources of the basin.

2. LAKE FRANCES

Lake Frances lies on the border of Oklahoma and Arkansas and serves as the upstream boundary for the Scenic River designation. The main portion of the dam collapsed in 1991 and essentially no lake remains, although there is still some retardation of river flow.

A the time of the dam collapse the lake had experienced a high degree of siltation with sediment levels being over 15 feet at the dam. All of the lake bed (approximately 560 acres) is now exposed with several hundred thousand cubic meters of nutrient-enriched sediment being subject to removal by river flow. Water quality data taken during 1992 and 1993 from sites above and below the lake show that river turbidity increases below the lake, although not significantly. The major concern appears to be loss of sediment during storm events. At present the river channel skirts the south shore of the former lake; however, given the soft nature of the sediments and the tendency for rivers to meander, the potential for much of the lake sediment to be dislodged into the river is high. It is difficult to imagine that water quality in the river can be much improved until this situation is addressed as a high potential exists for release of sediment to the river.

a. POTENTIAL SOLUTIONS

1. Restore impoundment

2. Remove sediment material

3. Stabilize streambed

4. Wetland development

<u>Discussion of Potential Solutions</u>

1. Restoration (reconstruction) of the lake dam so that it serves as an impoundment would help to ensure that accumulated material stays in place. This would be a relatively expensive alternative; however, creation of a lake would provide long term

benefits for the river by acting as a sediment and nutrient trap. This would appear to be a popular solution for area residents and municipalities. However, creation of a lake with nutrient rich sediment would also likely result in a eutrophic impoundment. Thus, Lake Frances would likely have water quality problems that would affect the river downstream in both positive and negative ways. Although creation of a sediment trap seems like a positive impact for the river, the reimpoundment would likely result in significant entrenchment and widening of the river downstream along with increased sediment loads from this process. Reimpounding Lake Frances would likely result in increased water quality problems downstream, rather than fewer.

2. The removal of the accumulated material would ensure that it is never washed into the river system. Since there is such a large volume of material, this would be a considerable undertaking, although the dry condition of the lake bed makes this type of dredging easier and less expensive. This option does not necessarily involve removal of all sediment as that which is some distance from the river edge may be safe from erosion. It is likely that option 1 would include some sediment removal.

3. Stabilization of the streambed to lessen the potential for erosion is a relatively inexpensive option. It has not been determined whether this option could provide for adequate protection from erosion; however, this approach would appear to have significant potential. This would involve revegetation of the lake bottom with erosion resistant plant species combined with river bank stabilization using Rosgen method techniques. Since 1991, the river has begun to stabilize itself through this section and as long as major disturbances do not occur upstream or downstream, this could be a very effective method of preventing Lake Frances sediment from polluting the river.

4. The lake bed now exhibits many characteristics of a wetland. These properties could be augmented with the establishment of wetland vegetation and control of water levels. Water traveling through such a system would be stripped of much of the nutrient and sediment load. However, structures to control water levels must be developed with care so as not to effect the natural tendencies of the river upstream or downstream.

b. RESPONSIBLE ENTITIES

It is difficult to determine which entities are responsible for the Lake Frances at this point. The following entities would potentially be involved in any clean-up effort:

Oklahoma Scenic Rivers Commission

Oklahoma Conservation Commission
City of Siloam Springs
Oklahoma Water Resources Board
Oklahoma Department of Environmental Quality
Adair County Conservation District
State of Arkansas

c. STATE GOALS

The goal of the state is to repair or remediate the situation in what remains of Lake Frances so that lake sediments are removed or stabilized to the point where they do not contribute to water quality problems in the Illinois River. The Oklahoma Conservation Commission (OCC) has initiated an investigation into potential solutions working with USEPA. Wetland development could be funded through the EPA wetland program.

d. COSTS

No firm costs estimate is available as this will be dependent upon the restoration/remediation plan chosen. It is estimated that costs could vary between $300,000 and $1,000,000. However, the developing native vegetation could provide sufficient stabilization such that no funding will be required, rather just a provision to allow the vegetation to establish, rather than actions to clear it. This currently appears to be the case, however, certain reaches may require augmentation in the future, should the vegetation be insufficient. Possibly the most appropriate measures to take would be to allow the vegetation to establish itself for 4 or 5 more years while other problems in the watershed are focused on, and then reevaluate the site to determine whether augmentation of the stabilization process is necessary.

3. ANIMAL PRODUCTION OPERATIONS

Agricultural activities are very important in the basin with the majority of income being produced through cattle, hogs, and poultry operations. The Oklahoma Conservation Commission (OCC) conducted a survey of animal production operations in 1997 to update 1989 Natural Resources Conservation Service (NRCS) numbers. Estimates were based on site visits and usually a discussion with the grower. This method allowed differentiation between active and inactive sites and additionally allows recording of the name of the producer and the company they grow for. Using existing aerial photos and USGS 7.5" topographic maps as a starting point, all roads were driven. Houses are all marked at the driveway or entrance from the nearest public road by easily visible signs so that the company feed and animal transporting truck drivers can easily find them. Using these signs, previously mapped houses were verified and those which didn't appear on any of the NRCS or USGS maps were mapped. **Figure 12** shows the location of confined animal feeding operations (CAFOs) in the Oklahoma portion of the Illinois River Watershed.

Table 20 lists the growers in the Oklahoma portion of the Illinois River Basin by location, the number and type of animals produced, and the company they are produced for. Listed are all sites surveyed in the 1997 assessment. Also listed are sites that were active in the NRCS 1985 survey which are no longer active (no longer in production (NIP) and not standing (NS)).

Table 21, **Table 22**, **Table 23**, **Table 24**, and **Table 25** list the subwatersheds of the Illinois River from the Lake Tenkiller dam to the Oklahoma border. The GIS number column refers to the identification number of each subwatershed on the map. Areas not draining to major tributaries or draining directly to the Illinois River are delineated and referred to as Illinois Laterals. They are designated either North or South depending on their position relative to the Illinois River, and are located along the Illinois River by the occurrence of major tributaries which form their East-West boundaries. The size column lists the size of each mapping unit in square miles. Sites indicated the number of animal producers. One site can have any number of houses. Houses refers to the actual number of buildings used to raise animals. The column labeled animals refers to the actual number of chickens, turkeys, dairy cattle, hogs, etc. for a particular watershed or subwatershed.

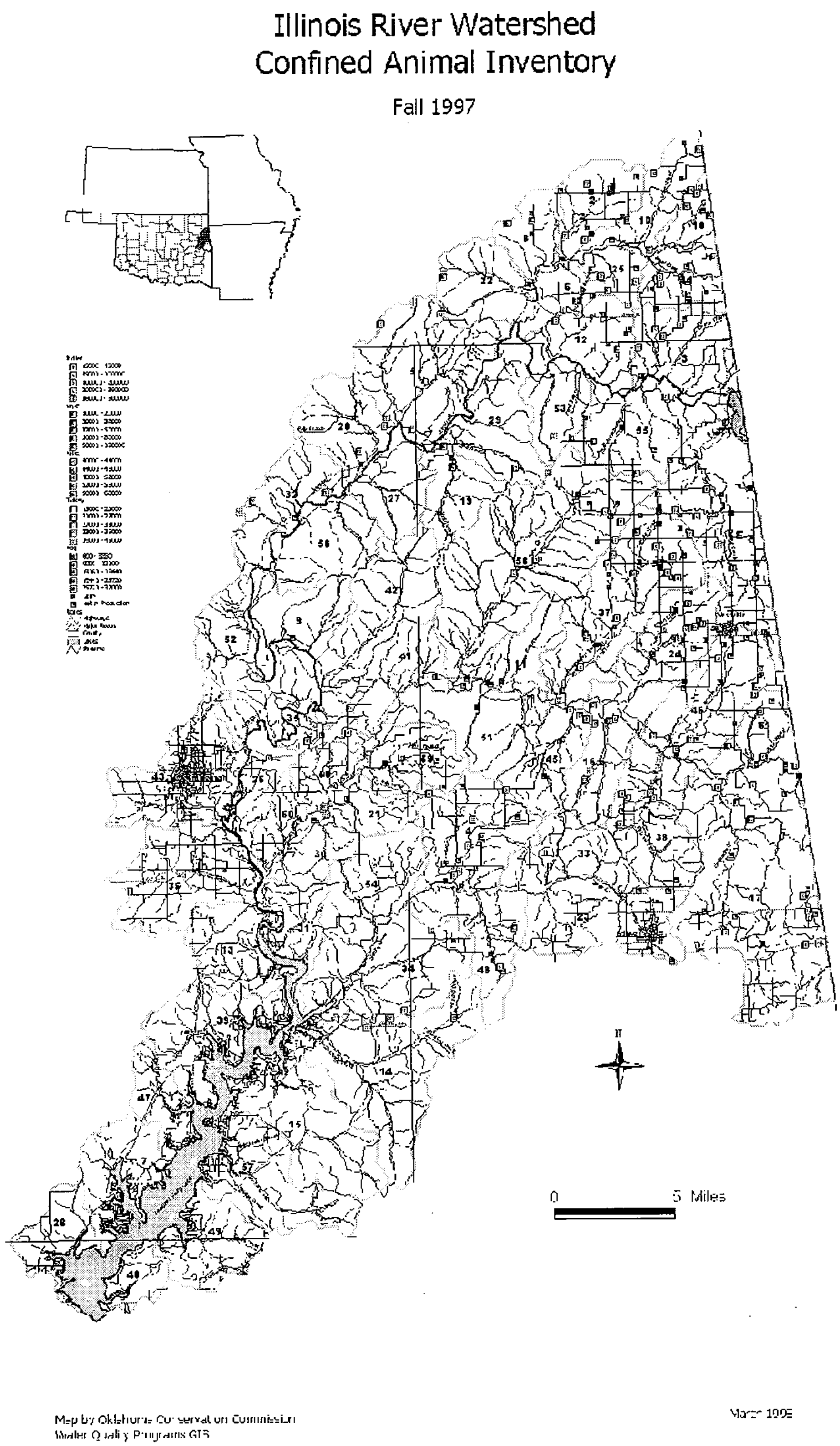

Figure 12. Confined Animal Feeding Operations in the Illinois River Watershed.

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
102P	Broiler	2	400	40,000	Tyson	Tyner Creek
103P	Broiler	2	400	40,000	Tyson	Tyner Creek
108P	Broiler	2	400	40,000	Tyson	Peacheater Creek
109P	Broiler	2	400	40,000	Hudson	Green Creek
10P	Broiler	3	400	60,000		
111P	Broiler	3	400	60,000	Hudson	Peacheater Creek
113P	Broiler	2	400	40,000	Tyson	Peacheater Creek
115P	Broiler	3	400	60,000	Tyson	Peacheater Creek
120P	Broiler	3	400	60,000	Hudson	Ballard Creek
124P	Broiler	4	400	80,000		Ballard Creek
125P	Broiler	2	300	30,000	Hudson	Ballard Creek
127P	Broiler	3	400	60,000	Hudson	Ballard Creek
128P	Broiler	3	400	60,000	Hudson	Ballard Creek
134P	Broiler	1	400	20,000	Simmon's	Peacheater Creek
135P	Broiler	2	400	40,000	Simmon's	Peacheater Creek
136P	Broiler	1	300	15,000	Simmon's	Scraper Hollow Creek
137P	Broiler	2	400	40,000	Simmon's	Scraper Hollow Creek
138P	Broiler	2	400	40,000	Hudson	Scraper Hollow Creek
139P	Broiler	1	400	20,000	Hudson	England Hollow Creek
141P	Broiler	2	400	40,000	Simmon's	Peavine Branch
144P	Broiler	2	400	40,000	Simmon's	Shell Branch
145P	Broiler	4	400	80,000		Peavine Branch
146P	Broiler	2	400	40,000	Simmon's	Peavine Branch
147P	Broiler	2	400	40,000	Hudson	Peavine Branch
14P	Broiler	1	400	20,000	Peterson	
150P	Broiler	2	400	40,000	Cal-Maine	Scraper Hollow Creek
153P	Broiler	3	400	60,000	Hudson	Bidding Creek
156P	Broiler	1	400	20,000	Tyson	Green Creek
157P	Broiler	3	400	55,000	Tyson	Green Creek
159P	Broiler	2	400	40,000	Hudson	Green Creek
15P	Broiler	4	400	80,000	Peterson	Fagan Creek
160P	Broiler	18	400	360,000	Hudson	Green Creek
163P	Broiler	15	400	300,000	Hudson	Green Creek
16P	Broiler	2	400	40,000	Simmon's	Fagan Creek
171P	Broiler	2	400	40,000	Simmon's	Shell Branch
174P	Broiler	1	400	20,000	Simmon's	Shell Branch
17P	Broiler	2	400	40,000	Simmon's	Crazy Creek
185P	Broiler	2	300	45,000	Tyson	West Branch
188P	Broiler	3	400	20,000	Simmon's	West Branch
189P	Broiler	1	400	40,000	Simmon's	West Branch

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
192P	Broiler	2	400	20,000	Cal-Maine	Shell Branch
196P	Broiler	1	300	40,000	Hudson	Shell Branch
1P	Broiler	2	400	60,000	George's	Crazy Creek
206P	Broiler	3	400	40,000	Simmon's	South Briggs Hollow
207P	Broiler	2	400	60,000	Hudson	Proctor Mountain Creek
219P	Broiler	3	300	45,000	Hudson	Walltrip Branch
222P	Broiler	3	400	60,000	Hudson	Field Hollow
223P	Broiler	3	400	40,000	Hudson	Bidding Creek
224P	Broiler	2	400	60,000	Simmon's	Negro Jake Creek
226P	Broiler	2	400	40,000	Simmon's	Dry Creek & Bolin Hollow
227P	Broiler	1	400	20,000	Simmon's	Dry Creek & Bolin Hollow
228P	Broiler	1	300	15,000	Hudson	Negro Jake Hollow
22P	Broiler	2	400	40,000	Hudson	Sager Creek
231P	Broiler	2	400	40,000	Simmon's	Bidding Creek
232P	Broiler	3	400	60,000	Simmon's	Bidding Creek
236P	Broiler	3	400	60,000	Simmon's	Bidding Creek
23P	Broiler	5	400	100,000	Hudson	Sager Creek
241P	Broiler	3	400	60,000	Hudson	
242P	Broiler	2	400	40,000	Hudson	
249P	Broiler	2	400	40,000	Hudson	Ill. R. Echota Bend Laterals
24P	Broiler	2	400	40,000	Hudson	Sager Creek
250P	Broiler	2	400	40,000	Hudson	North Briggs Hollow
252P	Broiler	2	400	40,000	Hudson	
253P	Broiler	3	400	60,000	Hudson	
254P	Broiler	2	400	40,000	Hudson	
259P	Broiler	4	400	80,000	Peterson	
260P	Broiler	2	400	40,000	Peterson	
262P	Broiler	2	400	40,000	Simmon's	Falls Branch
263P	Broiler	2	300	40,000	Simmon's	Falls Branch
265P	Broiler	1	400	20,000	Simmon's	Evansville Creek
273P	Broiler	2	400	40,000	Simmon's	Ballard Creek
274P	Broiler	1	400	20,000	Simmon's	Ballard Creek
277P	Broiler	30	300	600,000	Hudson	Ballard Creek
280P	Broiler	3	400	60,000	Hudson	England Hollow Creek
281P	Broiler	1	400	20,000	Hudson	England Hollow Creek
282P	Broiler	2	400	40,000	Simmon's	England Hollow Creek
283P	Broiler	1	400	20,000	Hudson	Peacheater Creek
288P	Broiler	2	400	40,000	Hudson	Evansville Creek
289P	Broiler	3	400	60,000	Simmon's	Evansville Creek
291P	Broiler	2	400	40,000	Simmon's	Evansville Creek
292P	Broiler	2	400	40,000	Cargill	Evansville Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
303P	Broiler	2	400	40,000	Simmon's	Smith Hollow
306P	Broiler	6	400	100,000	Simmon's	
308P	Broiler	3	400	60,000	Simmon's	Evansville Creek
309P	Broiler	1	400	20,000	Simmon's	Evansville Creek
30P	Broiler	2	400	40,000		Sager Creek
310P	Broiler	2	400	40,000	Simmon's	
311P	Broiler	2	400	40,000	Simmon's	
312P	Broiler	5	400	100,000	Simmon's	
32P	Broiler	2	400	40,000	Peterson	Beaver Creek
34P	Broiler	1	400	20,000	Simmon's	Beaver Creek
35P	Broiler	2	400	40,000	Simmon's	Beaver Creek
36P	Broiler	2	400	40,000	Tyson	
42P	Broiler	2	400	40,000	Tyson	Battle Branch
47P	Broiler	2	400	40,000	Simmon's	Crazy Creek
49P	Broiler	2	400	40,000	Cobb-Vantress	Tate Parrish Branch
51P	Broiler	8	400	160,000	George's	Blue Spring Branch
52P	Broiler	2	400	40,000	Simmon's	Dripping Spring Branch
54P	Broiler	2	400	40,000	Hudson	Hazelnut Hollow
56P	Broiler	8	400	160,000	George's	Hazelnut Hollow
59P	Broiler	4	400	80,000	Simmon's	Dripping Spring Branch
5P	Broiler	2	400	40,000	George's	
62P	Broiler	2	400	40,000	Simmon's	Beaver Creek
64P	Broiler	2	400	40,000	Simmon's	Dripping Spring Branch
66P	Broiler	4	400	80,000	Simmon's	Blackfox & Winset Hollow
67P	Broiler	4	400	80,000	Cobb-Vantress	
68P	Broiler	2	400	40,000	Peterson	
69P	Broiler	2	400	40,000	Peterson	Blackfox & Winset Hollow
6P	Broiler	3	400	60,000	Hudson	
75P	Broiler	1	400	20,000	Simmon's	
76P	Broiler	40	400	800,000	Hudson	
77P	Broiler	18	400	360,000	Hudson	
7P	Broiler	2	400	40,000	George's	Luna Branch
82P	Broiler	5	400	100,000	Hudson	Luna Branch
84P	Broiler	10	400	200,000	Hudson	Tahlequah, Kill Hollow, Rock Br
91P	Broiler	38	400	760,000	Hudson	
92P	Broiler	2	400	40,000	Simmon's	Tyner Creek
92P	Broiler	2	300	30,000	Simmon's	Tyner Creek
93P	Broiler	4	400	80,000	Simmon's	Tyner Creek
95P	Broiler	4	400	80,000	Tyson	Peacheater Creek
99P	Broiler	3	400	60,000	Simmon's	
9P	Broiler	2	400	40,000	Peterson	Peacheater Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
109P	Dairy			50		
118D	Dairy			90		Peacheater Creek
126D	Dairy			60		Ballard Creek
129D	Dairy			60		Peacheater Creek
140D	Dairy			60		England Hollow Creek
142P	Dairy			80		
148P	Dairy			60		
176D	Dairy			35		Shell Branch
178D	Dairy			60		Shell Branch
179D	Dairy			60		
194D	Dairy			60		Shell Branch
214D	Dairy			40		Dennison Creek
229D	Dairy			50		Negro Jake Hollow
22P	Dairy			80	Hudson	
230D	Dairy			50		Bidding Creek
237D	Dairy			40		Bidding Creek
240D	Dairy			40		Park Hill Branch
255D	Dairy			50		
258D	Dairy			60		Falls Branch
266D	Dairy			60		Ballard Creek
271D	Dairy			60		Ballard Creek
272D	Dairy			60		Ballard Creek
278D	Dairy			60		Ballard Creek
285D	Dairy			70		Dripping Springs Branch
28D	Dairy			60		Sager Creek
2D	Dairy			60		Crazy Creek
304D	Dairy			45		Smith Hollow
305D	Dairy			60		Smith Hollow
38D	Dairy			40		Calunchety Hollow
39D	Dairy			30		Calunchety Hollow
3D	Dairy			60		
44D	Dairy			80		Battle Branch
46D	Dairy			60		Battle Branch
48D	Dairy			100		Battle Branch
61P	Dairy			60		Dripping Spring Branch
73D	Dairy			60		Fall Branch
74D	Dairy			50		Fall Branch
80D	Dairy			40		Tate Parrish Branch
81D	Dairy			50		Tyner Creek
85D	Dairy			50		Tyner Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
86D	Dairy			65		Tyner Creek
87D	Dairy			40		Peacheater Creek
8D	Dairy			40		Crazy Creek
94D	Dairy			100		Tyner Creek
96D	Dairy			100		Peacheater Creek
97D	Dairy			40		Peacheater Creek
98D	Dairy			50		Peacheater Creek
998D	Dairy			50		Battle Branch
276P	Feed Mill				Hudson	Ballard Creek
131P	Hen	1	400	25,000	Simmon's	Peacheater Creek
132P	Hen	2	400	40,000	Simmon's	Peacheater Creek
142P	Hen	2	400	40,000	Hudson	Peavine Branch
177P	Hen	2	400	30,000		West Branch
180P	Hen	1	400	15,000	Simmon's	Evansville Creek
181P	Hen	2	400	30,000	Simmon's	Evansville Creek
191P	Hen	2	400	40,000	Cal-Maine	West Branch
193P	Hen	1	400	15,000	Cal-Maine	Shell Branch
20P	Hen	4	400	60,000	Tyson	Fagan Creek
21P	Hen	4	400	60,000	Tyson	Crazy Creek
270P	Hen	1	400	15,000	Simmon's	Ballard Creek
301P	Hen	1	400	15,000	Hudson	Smith Hollow
306P	Hen	2	400	30,000	Simmon's	
37P	Hen	2	400	30,000	Peterson	Calunchety Hollow
40P	Hen	12	400	180,000	Hudson	Calunchety Hollow
53P	Hen	2	400	30,000	Simmon's	Blue Spring Branch
55P	Hen	1	400	10,000	Peterson	Hazelnut Hollow
60P	Hen	4	400	80,000	Hudson	Dripping Spring Branch
65P	Hen	2	400	40,000	Tyson	Five Mile Hollow
71P	Hen	2	400	40,000	Cal-Maine	Fall Branch
72P	Hen	1	400	20,000	Cal-Maine	Fall Branch
79P	Hen	4	400	32,000	Cal-Maine	Tate Parrish Branch
88D	Hen	4	400	50,000	Cobb-Vantress	Tate Parrish Branch
90P	Hen	2	400	25,000	Cobb-Vantress	Peacheater Creek
18H	Hog			600	Tyson	Fagan Creek
78H	Hog	12	400	3,200	Tyson	Tahlequah, Kill Hollow, Rock Br
148P	Pullet	3	400	60,000	Cal-Maine	Five Mile Hollow
149P	Pullet	2	400	40,000	Cal-Maine	Dripping Spring Branch
173T	Turkey	3	400	30,000	Cargill	Shell Branch
225T	Turkey	3	400	45,000	Cargill	Negro Jake Hollow
235T	Turkey	2	300	30,000	Cargill	Bidding Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
238T	Turkey	3	400	45,000	Cargill	South Briggs Hollow
329T	Turkey	3	400	45,000	Cargill	South Briggs Hollow
243T	Turkey	2	400	30,000	Cargill	
244T	Turkey	3	400	45,000	Cargill	Mollyfield & Peavine Creeks
245T	Turkey	3	400	45,000	Cargill	Mollyfield & Peavine Creeks
246T	Turkey	2	400	30,000	Cargill	Mollyfield & Peavine Creeks
261T	Turkey	3	400	45,000	Cargill	Falls Branch
319T	Turkey	1	400	15,000	Cargill	Battle Branch
70T	Turkey	2	400	30,000	Cargill	Blackfox & Winset Hollow
100P	NIP					
101P	NIP					
104P	NIP					
105P	NIP					Peacheater Creek
106P	NIP					Peacheater Creek
107P	NIP					Peacheater Creek
110P	NIP					Green Creek
112P	NIP					Peacheater Creek
114P	NIP					Peacheater Creek
116P	NIP					Peacheater Creek
117P	NIP					Ballard Creek
119P	NIP					Ballard Creek
11P	NIP					Battle Branch
121P	NIP					Tate Parrish Branch
122P	NIP					Ballard Creek
123P	NIP					Ballard Creek
12P	NIP					Battle Branch
130P	NIP					Peacheater Creek
133P	NIP					Peacheater Creek
13P	NIP					Battle Branch
143P	NIP					Peavine Branch
151P	NIP					Scraper Hollow Creek
155P	NIP					Bidding Creek
158P	NIP					Green Creek
161P	NIP					Green Creek
162P	NIP					Green Creek
164P	NIP					Green Creek
165P	NIP					Green Creek
166P	NIP					Green Creek
168P	NIP					Green Creek
169P	NIP					Shell Branch

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
170P	NIP					Shell Branch
172P	NIP					Shell Branch
175P	NIP					Shell Branch
182P	NIP					Evansville Creek
183P	NIP					Evansville Creek
184P	NIP					Evansville Creek
186P	NIP					West Branch
187P	NIP					West Branch
190P	NIP					West Branch
195P	NIP					Shell Branch
199P	NIP					Ballard Creek
19P	NIP					Fagan Creek
200P	NIP					Ballard Creek
201P	NIP					Shell Branch
202P	NIP					Ballard Creek
203P	NIP					Shell Branch
204P	NIP					Shell Branch
205P	NIP					Shell Branch
208P	NIP					South Briggs Hollow
209P	NIP					Proctor Mountain Creek
210P	NIP					Tyner Creek
211P	NIP					Tyner Creek
212P	NIP					Dennison Creek
213P	NIP					Dennison Creek
215P	NIP					Bidding Creek
216P	NIP					South Proctor Creek
217P	NIP					Walltrip Branch
218P	NIP					Walltrip Branch
220P	NIP					Walltrip Branch
221P	NIP					Field Hollow
233P	NIP					Bidding Creek
234P	NIP					Bidding Creek
247P	NIP					Cedar and Tully Hollows
251P	NIP					South Briggs Hollow
256P	NIP					Mollyfield & Peavine Creeks
257P	NIP					
25P	NIP					Sager Creek
264P	NIP					Shell Branch
268P	NIP					Ballard Creek
26P	NIP					Sager Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
175P	NIP					Ballard Creek
279P	NIP					Ballard Creek
27P	NIP					Sager Creek
284P	NIP					Beaver Creek
286P	NIP					Peavine Branch
287P	NIP					Mulberry Hollow
290P	NIP					Evansville Creek
293P	NIP					Evansville Creek
294P	NIP					Evansville Creek
295P	NIP					Evansville Creek
296P	NIP					Evansville Creek
299P	NIP					Mulberry Hollow
29P	NIP					Sager Creek
302P	NIP					Smith Hollow
307P	NIP					Evansville Creek
313P	NIP					Goat Mountain
317P	NIP					Battle Branch
31P	NIP					Beaver Creek
321P	NIP					Green Creek
33P	NIP					Beaver Creek
38D	NIP					
41P	NIP					Battle Branch
43P	NIP					Crazy Creek
45P	NIP					Battle Branch
4P	NIP					
50P	NIP					Crazy Creek
57P	NIP					Hazelnut Hollow
58P	NIP					Blue Spring Branch
63P	NIP					Dripping Spring Branch
83P	NIP					Tyner Creek
89P	NIP					Tate Parrish Branch
999P	NIP					Battle Branch
152P	NS					Scraper Hollow Creek
154P	NS					Bidding Creek
167P	NS					Green Creek
197P	NS					Shell Branch
198P	NS					Ballard Creek
248P	NS					
267P	NS					Ballard Creek
269P	NS					Ballard Creek

Table 20. List of Growers in Illinois River Watershed.

Site ID#	Type	Houses #	Sizes	# Animals	Company	Location
297P	NS					Mulberry Hollow
298P	NS					Peavine Branch
300P	NS					Mulberry Hollow
318P	NS					
314N	Nursery				Greenleaf Nursery	Petit Creek
315N	Nursery				Park Hill Nursery	Park Hill Branch
316N	Nursery				Midwestern Nursery	Steeley Hollow

Sites not standing are sites that appear on the USGS 1:24000 topographic maps but no longer exist. Sites not in production are houses that are standing and capable of production but were empty at the time of the site visit. Potential houses in production, potential animals, and potential animal density refer to the total number of animals that would exist if all empty houses were put into production along with those already producing. For ease of calculation, all empty houses are assumed to be chicken houses, rather than turkey houses.

Table 21. Subwatersheds in the Illinois River Basin and Poultry Production.

			Broiler				Layer			
Subwatershed	GIS label	Size (mi^2)	Sites	Houses	Animals	Animal Density (per mi^2)	Sites	Houses	Animals	Animal Density (per mi^2
Ballard Creek	1	25.19	8	48	950000	37719.18	1	1	15000	595.57
Battle Branch	2	9.33	1	2	40000	4286.92	0	0	0	0.00
Beaver Creek	3	14.51	4	7	140000	9649.50	0	0	0	0.00
Bidding Creek	4	17.46	5	13	260000	14893.59	0	0	0	0.00
Blackfox & Winset Hollow	5	22.92	1	2	40000	1744.97	0	0	0	0.00
Blue Spring Branch	6	5.28	1	8	160000	30284.76	1	2	30000	5678.39
Burnt Cabin Creek	7	12.32	0	0	0	0.00	0	0	0	0.00
Calunchety Hollow	8	6.95	0	0	0	0.00	1	12	180000	25907.94
Cedar Hollow & Tully Hollow	9	11.12	0	0	0	0.00	0	0	0	0.00
Crazy Creek	10	9.41	3	7	140000	14883.58	1	4	60000	6378.68
Dennison Creek	11	7.89	0	0	0	0.00	0	0	0	0.00
Dripping Spring Branch	12	11.35	3	8	160000	14093.79	1	4	80000	7046.89
Dripping Springs Hollow	13	11.76	0	0	0	0.00	0	0	0	0.00
Dry Creek & Bolin Hollow	14	27.48	2	3	60000	2183.63	0	0	0	0.00
Elk Creek	15	21.67	0	0	0	0.00	0	0	0	0.00
England Hollow Creek	16	9.46	4	7	140000	14805.01	0	0	0	0.00
Evansville Creek	17	48.52	8	16	320000	6594.64	2	3	45000	927.37
Fagan Creek	18	3.72	2	6	120000	32246.93	1	4	60000	16123.46
Fall Branch	19	8.62	0	0	0	0.00	2	3	60000	6962.59
Falls Branch	20	10.93	2	4	80000	7319.25	0	0	0	0.00
Field Hollow	21	6.64	1	3	60000	9036.18	0	0	0	0.00
Five Mile Hollow	22	11.23	0	0	0	0.00	1	2	40000	3563.03
Goat Mountain	23	12.6	0	0	0	0.00	0	0	0	0.00
Green Creek	24	15.6	6	41	815000	52232.73	0	0	0	0.00
Hazelnut Hollow	25	4.52	2	10	200000	44204.52	1	1	10000	2210.23
Illinois River Echota Bend	26	6.92	1	2	40000	5780.77	0	0	0	0.00
Kirk Springs & Sawmill Hollow	27	9.13	0	0	0	0.00	0	0	0	0.00
Linder Bend & Sawmill Hollow	28	8.46	0	0	0	0.00	0	0	0	0.00
Luna Branch	29	14.83	2	41	820000	55287.75	0	0	0	0.00
Mining Camp Hollow (North)	30	6.91	0	0	0	0.00	0	0	0	0.00
Mining Camp Hollow (South)	31	7.87	0	0	0	0.00	0	0	0	0.00
Mollyfield & Peavine Creeks	32	12.03	0	0	0	0.00	0	0	0	0.00
Mulberry Hollow	33	15.96	0	0	0	0.00	0	0	0	0.00
Negro Jake Hollow	34	16.98	2	4	75000	4417.58	0	0	0	0.00
North Briggs Hollow	35	2.11	1	2	40000	18920.30	0	0	0	0.00
Park Hill Branch	36	19.14	0	0	0	0.00	0	0	0	0.00
Peacheater Creek	37	25.34	11	27	570000	22496.43	3	5	90000	3552.07
Peavine Branch	38	16.14	4	10	200000	12390.12	1	2	40000	2478.02
Pettit Creek	39	15.51	0	0	0	0.00	0	0	0	0.00
Pine Hollow	40	5.12	0	0	0	0.00	0	0	0	0.00
Proctor Mountain Creek	41	10.03	1	3	60000	5980.55	0	0	0	0.00
Pumpkin Hollow	42	18.66	0	0	0	0.00	0	0	0	0.00
Ross Branch & Tahlequah Cr	43	18.35	0	0	0	0.00	0	0	0	0.00
Sager Creek	44	8.24	4	11	220000	26711.18	0	0	0	0.00
Scraper Hollow Creek	45	9.33	4	7	135000	14468.73	0	0	0	0.00
Shell Branch	46	17.58	5	8	160000	9099.72	1	1	15000	853.10
Sizemore Creek	47	6.99	0	0	0	0.00	0	0	0	0.00

Table 21. Subwatersheds in the Illinois River Basin and Poultry Production.

			Broiler				Layer			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2**
Smith Hollow	48	12.62	1	2	40000	3169.49	1	1	15000	1188.56
Snake & Cato Creek	49	11.42	0	0	0	0.00	0	0	0	0.00
South Briggs Hollow	50	7.59	1	2	40000	5271.60	0	0	0	0.00
South Proctor Creek	51	14.63	0	0	0	0.00	0	0	0	0.00
Steeley Hollow	52	18.59	0	0	0	0.00	0	0	0	0.00
Tahlequah & Kill Hollow & Rock Br	53	8.29	1	18	360000	43417.17	0	0	0	0.00
Tailhot Creek	54	18.56	0	0	0	0.00	0	0	0	0.00
Tate Parrish Branch	55	16.68	1	2	40000	2397.71	2	8	82000	4915.30
Telamay H. & Dog Hollow	56	12.37	0	0	0	0.00	0	0	0	0.00
Terrapin Creek	57	17.44	0	0	0	0.00	0	0	0	0.00
Tyner Creek	58	42.67	5	57	1140000	26714.04	0	0	0	0.00
Walltrip Branch	59	9.96	1	3	45000	4517.56	0	0	0	0.00
Welling Creek	60	4.98	0	0	0	0.00	0	0	0	0.00
West Branch	61	7.77	3	6	105000	13518.35	2	4	70000	9012.24
Total Watershed	T	**821.69**	**101**	**390**	**7,775,000**	**946.00**	**22**	**57**	**892,000**	**1085.57**

Table 22. Turkey Production in Illinois River Basin Subwatersheds.

			Turkey				Pullet			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (mi^2)**
Ballard Creek	1	25.19	0	0	0	0.00	0	0	0	0
Battle Branch	2	9.33	2	4	60000	6430.39	0	0	0	0
Beaver Creek	3	14.51	0	0	0	0.00	0	0	0	0
Bidding Creek	4	17.46	1	2	30000	1718.49	0	0	0	0
Blackfox & Winset Hollow	5	22.92	1	2	30000	1308.73	0	0	0	0
Blue Spring Branch	6	5.28	0	0	0	0.00	0	0	0	0
Burnt Cabin Creek	7	12.32	0	0	0	0.00	0	0	0	0
Calunchety Hollow	8	6.95	0	0	0	0.00	0	0	0	0
Cedar Hollow & Tully Hollow	9	11.12	0	0	0	0.00	0	0	0	0
Crazy Creek	10	9.41	0	0	0	0.00	0	0	0	0
Dennison Creek	11	7.89	0	0	0	0.00	0	0	0	0
Dripping Spring Branch	12	11.35	0	0	0	0.00	0	0	0	0
Dripping Springs Hollow	13	11.76	0	0	0	0.00	0	0	0	0
Dry Creek & Bolin Hollow	14	27.48	0	0	0	0.00	0	0	0	0
Elk Creek	15	21.67	0	0	0	0.00	0	0	0	0
England Hollow Creek	16	9.46	0	0	0	0.00	2	5	100000	10575.00
Evansville Creek	17	48.52	0	0	0	0.00	0	0	0	0
Fagan Creek	18	3.72	0	0	0	0.00	0	0	0	0
Fall Branch	19	8.62	0	0	0	0.00	0	0	0	0
Falls Branch	20	10.93	1	3	45000	4117.08	0	0	0	0
Field Hollow	21	6.64	0	0	0	0.00	0	0	0	0
Five Mile Hollow	22	11.23	0	0	0	0.00	0	0	0	0
Goat Mountain	23	12.60	0	0	0	0.00	0	0	0	0
Green Creek	24	15.60	0	0	0	0.00	0	0	0	0
Hazelnut Hollow	25	4.52	0	0	0	0.00	0	0	0	0
Illinois River Echota Bend Laterals	26	6.92	0	0	0	0.00	0	0	0	0
Kirk Springs & Sawmill Hollow	27	9.13	0	0	0	0.00	0	0	0	0
Linder Bend & Sawmill Hollow	28	8.46	0	0	0	0.00	0	0	0	0
Luna Branch	29	14.83	0	0	0	0.00	0	0	0	0
Mining Camp Hollow (North)	30	6.91	0	0	0	0.00	0	0	0	0
Mining Camp Hollow (South)	31	7.87	0	0	0	0.00	0	0	0	0
Mollyfield & Peavine Creeks	32	12.03	2	5	75000	6232.32	0	0	0	0
Mulberry Hollow	33	15.96	0	0	0	0.00	0	0	0	0
Negro Jake Hollow	34	16.98	1	3	45000	2650.55	0	0	0	0
North Briggs Hollow	35	2.11	0	0	0	0.00	0	0	0	0
Park Hill Branch	36	19.14	0	0	0	0.00	0	0	0	0
Peacheater Creek	37	25.34	0	0	0	0.00	0	0	0	0
Peavine Branch	38	16.14	0	0	0	0.00	0	0	0	0
Pettit Creek	39	15.51	0	0	0	0.00	0	0	0	0
Pine Hollow	40	5.12	0	0	0	0.00	0	0	0	0
Proctor Mountain Creek	41	10.03	0	0	0	0.00	0	0	0	0
Pumpkin Hollow	42	18.66	0	0	0	0.00	0	0	0	0
Ross Branch & Tahlequah Creek	43	18.35	0	0	0	0.00	0	0	0	0
Sager Creek	44	8.24	0	0	0	0.00	0	0	0	0
Scraper Hollow Creek	45	9.33	0	0	0	0.00	0	0	0	0
Shell Branch	46	17.58	1	3	30000	1706.20	0	0	0	0
Sizemore Creek	47	6.99	0	0	0	0.00	0	0	0	0

Table 22. Turkey Production in Subwatersheds of the Illinois River Basin Continued.

			Turkey				Pullet			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (mi^2)**
Smith Hollow	48	12.62	0	0	0	0.00	0	0	0	0
Snake & Cato Creek	49	11.42	0	0	0	0.00	0	0	0	0
South Briggs Hollow	50	7.59	2	6	90000	11861.09	0	0	0	0
South Proctor Creek	51	14.63	0	0	0	0.00	0	0	0	0
Steeley Hollow	52	18.59	0	0	0	0.00	0	0	0	0
Tahlequah & Kill Hollow & Rock Br	53	8.29	0	0	0	0.00	0	0	0	0
Tailhot Creek	54	18.56	0	0	0	0.00	0	0	0	0
Tate Parrish Branch	55	16.68	0	0	0	0.00	0	0	0	0
Telamay H. & Dog Hollow	56	12.37	0	0	0	0.00	0	0	0	0
Terrapin Creek	57	17.44	0	0	0	0.00	0	0	0	0
Tyner Creek	58	42.67	0	0	0	0.00	0	0	0	0
Walltrip Branch	59	9.96	0	0	0	0.00	0	0	0	0
Welling Creek	60	4.98	0	0	0	0.00	0	0	0	0
West Branch	61	7.77	0	0	0	0.00	0	0	0	0
Total Watershed	**T**	**821.69**	**11**	**28**	**405,000**	**492.89**	**2**	**5**	**100,000**	**122**

Table 23. Dairy and Swine Production in Subwatersheds in the Illinois River Basin.

			Dairy				Hog			
Subwatershed	GIS label	Size (mi^2)	Sites	Houses	Animals	Animal Density (per mi^2)	Sites	Houses	Animals	Animal Density (per mi^2)
Ballard Creek	1	25.19	5	0	300	11.91	0	0	0	0.00
Battle Branch	2	9.33	4	0	290	31.08	0	0	0	0.00
Beaver Creek	3	14.51	0	0	0	0.00	0	0	0	0.00
Bidding Creek	4	17.46	2	0	90	5.16	0	0	0	0.00
Blackfox & Winset Hollow	5	22.92	0	0	0	0.00	0	0	0	0.00
Blue Spring Branch	6	5.28	0	0	0	0.00	0	0	0	0.00
Burnt Cabin Creek	7	12.32	0	0	0	0.00	0	0	0	0.00
Calunchety Hollow	8	6.95	2	0	70	10.08	0	0	0	0.00
Cedar Hollow & Tully Hollow	9	11.12	0	0	0	0.00	0	0	0	0.00
Crazy Creek	10	9.41	2	0	100	10.63	0	0	0	0.00
Dennison Creek	11	7.89	1	0	40	5.07	0	0	0	0.00
Dripping Spring Branch	12	11.35	2	0	130	11.45	0	0	0	0.00
Dripping Springs Hollow	13	11.76	0	0	0	0.00	0	0	0	0.00
Dry Creek & Bolin Hollow	14	27.48	0	0	0	0.00	0	0	0	0.00
Elk Creek	15	21.67	0	0	0	0.00	0	0	0	0.00
England Hollow Creek	16	9.46	2	0	120	12.69	0	0	0	0.00
Evansville Creek	17	48.52	1	0	60	1.24	0	0	0	0.00
Fagan Creek	18	3.72	0	0	0	0.00	1	0	600	161.23
Fall Branch	19	8.62	2	0	110	12.76	0	0	0	0.00
Falls Branch	20	10.93	1	0	60	5.49	0	0	0	0.00
Field Hollow	21	6.64	0	0	0	0.00	0	0	0	0.00
Five Mile Hollow	22	11.23	0	0	0	0.00	0	0	0	0.00
Goat Mountain	23	12.60	0	0	0	0.00	0	0	0	0.00
Green Creek	24	15.60	1	0	50	3.20	0	0	0	0.00
Hazelnut Hollow	25	4.52	0	0	0	0.00	0	0	0	0.00
Illinois River Echota Bend Laterals	26	6.92	0	0	0	0.00	0	0	0	0.00
Kirk Springs & Sawmill Hollow	27	9.13	0	0	0	0.00	0	0	0	0.00
Linder Bend & Sawmill Hollow	28	8.46	0	0	0	0.00	0	0	0	0.00
Luna Branch	29	14.83	0	0	0	0.00	0	0	0	0.00
Mining Camp Hollow (North)	30	6.91	0	0	0	0.00	0	0	0	0.00
Mining Camp Hollow (South)	31	7.87	0	0	0	0.00	0	0	0	0.00
Mollyfield & Peavine Creeks	32	12.03	0	0	0	0.00	0	0	0	0.00
Mulberry Hollow	33	15.96	0	0	0	0.00	0	0	0	0.00
Negro Jake Hollow	34	16.98	1	0	50	2.95	0	0	0	0.00
North Briggs Hollow	35	2.11	0	0	0	0.00	0	0	0	0.00
Park Hill Branch	36	19.14	1	0	40	2.09	0	0	0	0.00
Peacheater Creek	37	25.34	6	0	380	15.00	0	0	0	0.00
Peavine Branch	38	16.14	1	0	80	4.96	0	0	0	0.00
Pettit Creek	39	15.51	0	0	0	0.00	0	0	0	0.00
Pine Hollow	40	5.12	0	0	0	0.00	0	0	0	0.00
Proctor Mountain Creek	41	10.03	0	0	0	0.00	0	0	0	0.00
Pumpkin Hollow	42	18.66	0	0	0	0.00	0	0	0	0.00
Ross Branch & Tahlequah Creek	43	18.35	0	0	0	0.00	0	0	0	0.00
Sager Creek	44	8.24	2	0	140	17.00	0	0	0	0.00
Scraper Hollow Creek	45	9.33	0	0	0	0.00	0	0	0	0.00
Shell Branch	46	17.58	3	0	155	8.82	0	0	0	0.00
Sizemore Creek	47	6.99	0	0	0	0.00	0	0	0	0.00

Table 23. Dairy and Swine Production in Subwatersheds in the Illinois River Basin Continued.

			Dairy				Hog			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2)**
Smith Hollow	48	12.62	2	0	105	8.32	0	0	0	0.00
Snake & Cato Creek	49	11.42	0	0	0	0.00	0	0	0	0.00
South Briggs Hollow	50	7.59	0	0	0	0.00	0	0	0	0.00
South Proctor Creek	51	14.63	0	0	0	0.00	0	0	0	0.00
Steeley Hollow	52	18.59	0	0	0	0.00	0	0	0	0.00
Tahlequah & Kill Hollow & Rock Br	53	8.29	0	0	0	0.00	1	12	32000	3859.30
Tailhot Creek	54	18.56	0	0	0	0.00	0	0	0	0.00
Tate Parrish Branch	55	16.68	1	0	40	2.40	0	0	0	0.00
Telamay H. & Dog Hollow	56	12.37	0	0	0	0.00	0	0	0	0.00
Terrapin Creek	57	17.44	0	0	0	0.00	0	0	0	0.00
Tyner Creek	58	42.67	4	0	265	6.21	0	0	0	0.00
Walltrip Branch	59	9.96	0	0	0	0.00	0	0	0	0.00
Welling Creek	60	4.98	0	0	0	0.00	0	0	0	0.00
West Branch	61	7.77	0	0	0	0.00	0	0	0	0.00
Total Watershed	T	**821.69**	**46**	**0**	**2,675**	**3.26**	**2**	**12**	**32,600**	**39.67**

Table 24. Beef Production in Subwatersheds of the Illinois River Basin.

			Beef Cattle			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2)**
Ballard Creek	1	25.19	0	0	2600	103.23
Battle Branch	2	9.33	0	0	400	42.87
Beaver Creek	3	14.51	0	0	890	61.34
Bidding Creek	4	17.46	0	0	890	50.98
Blackfox & Winset Hollow	5	22.92	0	0	1600	69.80
Blue Spring Branch	6	5.28	0	0	550	104.10
Burnt Cabin Creek	7	12.32	0	0	150	12.17
Calunchety Hollow	8	6.95	0	0	300	43.18
Cedar Hollow & Tully Hollow	9	11.12	0	0	790	71.04
Crazy Creek	10	9.41	0	0	500	53.16
Dennison Creek	11	7.89	0	0	840	106.44
Dripping Spring Branch	12	11.35	0	0	1200	105.70
Dripping Springs Hollow	13	11.76	0	0	400	34.01
Dry Creek & Bolin Hollow	14	27.48	0	0	660	24.02
Elk Creek	15	21.67	0	0	50	2.31
England Hollow Creek	16	9.46	0	0	1000	105.75
Evansville Creek	17	48.52	0	0	3000	61.82
Fagan Creek	18	3.72	0	0	210	56.43
Fall Branch	19	8.62	0	0	610	70.79
Falls Branch	20	10.93	0	0	900	82.34
Field Hollow	21	6.64	0	0	500	75.30
Five Mile Hollow	22	11.23	0	0	300	26.72
Goat Mountain	23	12.60	0	0	770	61.10
Green Creek	24	15.60	0	0	1600	102.54
Hazelnut Hollow	25	4.52	0	0	400	88.41
Illinois River Echota Bend Laterals	26	6.92	0	0	0	0.00
Kirk Springs & Sawmill Hollow	27	9.13	0	0	650	71.19
Linder Bend & Sawmill Hollow	28	8.46	0	0	150	17.73
Luna Branch	29	14.83	0	0	900	60.68
Mining Camp Hollow (North)	30	6.91	0	0	730	105.67
Mining Camp Hollow (South)	31	7.87	0	0	830	105.44
Mollyfield & Peavine Creeks	32	12.03	0	0	850	70.63
Mulberry Hollow	33	15.96	0	0	1700	106.52
Negro Jake Hollow	34	16.98	0	0	1800	106.02
North Briggs Hollow	35	2.11	0	0	640	302.72
Park Hill Branch	36	19.14	0	0	250	13.06
Peacheater Creek	37	25.34	0	0	2700	106.56
Peavine Branch	38	16.14	0	0	1700	105.32
Pettit Creek	39	15.51	0	0	300	19.34
Pine Hollow	40	5.12	0	0	100	19.53
Proctor Mountain Creek	41	10.03	0	0	800	79.74
Pumpkin Hollow	42	18.66	0	0	1300	69.66
Ross Branch & Tahlequah Creek	43	18.35	0	0	150	8.18
Sager Creek	44	8.24	0	0	300	36.42
Scraper Hollow Creek	45	9.33	0	0	1190	127.54
Shell Branch	46	17.58	0	0	1800	102.37
Sizemore Creek	47	6.99	0	0	220	31.47

Table 24. Beef Production in Subwatersheds of the Illinois River Basin Continued.

			Beef Cattle			
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Houses**	**Animals**	**Animal Density (per mi^2)**
Smith Hollow	48	12.62	0	0	1300	103.01
Snake & Cato Creek	49	11.42	0	0	150	13.13
South Briggs Hollow	50	7.59	0	0	540	71.17
South Proctor Creek	51	14.63	0	0	900	61.53
Steeley Hollow	52	18.59	0	0	1300	69.91
Tahlequah & Kill Hollow & Rock Br	53	8.29	0	0	590	71.16
Tailhot Creek	54	18.56	0	0	1250	67.36
Tate Parrish Branch	55	16.68	0	0	450	26.97
Telamay H. & Dog Hollow	56	12.37	0	0	880	71.15
Terrapin Creek	57	17.44	0	0	50	2.87
Tyner Creek	58	42.67	0	0	3000	70.30
Walltrip Branch	59	9.96	0	0	1270	127.50
Welling Creek	60	4.98	0	0	530	106.36
West Branch	61	7.77	0	0	820	105.57
Total Watershed	T	**821.69**	**0**	**0**	**53,200**	**64.74**

Table 25. Nurseries, Residences, Feed Mills, and Houses Not in Production or Not Standing in the Watershed.

			Nursery		Residential Houses	NIP		NS		Feed Mill
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Area**	**Houses**	**Sites**	**Houses**	**Sites**	**Houses**	**Sites**
Ballard Creek	1	25.19	0	0.00	140	10	0	3	0	1
Battle Branch	2	9.33	0	0.00	135	6	0	0	0	0
Beaver Creek	3	14.51	0	0.00	225	3	0	0	0	0
Bidding Creek	4	17.46	0	0.00	190	4	0	1	0	0
Blackfox & Winset Hollow	5	22.92	0	0.00	265	0	0	0	0	0
Blue Spring Branch	6	5.28	0	0.00	50	1	0	0	0	0
Burnt Cabin Creek	7	12.32	0	0.00	70	0	0	0	0	0
Calunchety Hollow	8	6.95	0	0.00	107	1	0	0	0	0
Cedar Hollow & Tully Hollow	9	11.12	0	0.00	20	1	0	0	0	0
Crazy Creek	10	9.41	0	0.00	173	2	0	0	0	0
Dennison Creek	11	7.89	0	0.00	0	2	0	0	0	0
Dripping Spring Branch	12	11.35	0	0.00	33	2	0	0	0	0
Dripping Springs Hollow	13	11.76	0	0.00	35	0	0	0	0	0
Dry Creek & Bolin Hollow	14	27.48	0	0.00	82	0	0	0	0	0
Elk Creek	15	21.67	0	0.00	215	0	0	0	0	0
England Hollow Creek	16	9.46	0	0.00	45	0	0	0	0	0
Evansville Creek	17	48.52	0	0.00	330	9	0	0	0	0
Fagan Creek	18	3.72	0	0.00	26	1	0	0	0	0
Fall Branch	19	8.62	0	0.00	64	0	0	0	0	0
Falls Branch	20	10.93	0	0.00	25	0	0	0	0	0
Field Hollow	21	6.64	0	0.00	30	1	0	0	0	0
Five Mile Hollow	22	11.23	0	0.00	155	1	0	0	0	0
Goat Mountain	23	12.60	0	0.00	90	1	0	0	0	0
Green Creek	24	15.60	0	0.00	140	9	0	1	0	0
Hazelnut Hollow	25	4.52	0	0.00	50	1	0	0	0	0
Illinois River Echota Bend Laterals	26	6.92	0	0.00	0	0	0	0	0	0
Kirk Springs & Sawmill Hollow	27	9.13	0	0.00	40	0	0	0	0	0
Linder Bend & Sawmill Hollow	28	8.46	0	0.00	400	0	0	0	0	0
Luna Branch	29	14.83	0	0.00	30	0	0	0	0	0
Mining Camp Hollow (North)	30	6.91	0	0.00	10	0	0	0	0	0
Mining Camp Hollow (South)	31	7.87	0	0.00	85	0	0	0	0	0
Mollyfield & Peavine Creeks	32	12.03	0	0.00	36	1	0	0	0	0
Mulberry Hollow	33	15.96	0	0.00	140	2	0	2	0	0
Negro Jake Hollow	34	16.98	0	0.00	108	0	0	0	0	0
North Briggs Hollow	35	2.11	0	0.00	150	0	0	0	0	0
Park Hill Branch	36	19.14	1	0.40	330	0	0	0	0	0
Peacheater Creek	37	25.34	0	0.00	185	9	0	0	0	0
Peavine Branch	38	16.14	0	0.00	330	2	0	1	0	0
Pettit Creek	39	15.51	1	0.28	380	0	0	0	0	0
Pine Hollow	40	5.12	0	0.00	205	0	0	0	0	0
Proctor Mountain Creek	41	10.03	0	0.00	53	1	0	0	0	0
Pumpkin Hollow	42	18.66	0	0.00	55	0	0	0	0	0
Ross Branch & Tahlequah Creek	43	18.35	0	0.00	2500	0	0	0	0	0
Sager Creek	44	8.24	0	0.00	54	4	0	0	0	0
Scraper Hollow Creek	45	9.33	0	0.00	50	1	0	1	0	0
Shell Branch	46	17.58	0	0.00	100	10	0	1	0	0
Sizemore Creek	47	6.99	0	0.00	50	0	0	0	0	0

Table 25. Nurseries, Residences, Feed Mills, and Houses Not in Production or Not Standing in the Watershed.

			Nursery		Residential Houses	NIP		NS		Feed Mill
Subwatershed	**GIS label**	**Size (mi^2)**	**Sites**	**Area**	**Houses**	**Sites**	**Houses**	**Sites**	**Houses**	**Sites**
Smith Hollow	48	12.62	0	0.00	60	1	0	0	0	0
Snake & Cato Creek	49	11.42	0	0.00	207	0	0	0	0	0
South Briggs Hollow	50	7.59	0	0.00	55	2	0	0	0	0
South Proctor Creek	51	14.63	0	0.00	14	1	0	0	0	0
Steeley Hollow	52	18.59	1	0.08	140	0	0	0	0	0
Tahlequah & Kill Hollow & Rock Br	53	8.29	0	0.00	30	0	0	0	0	0
Tailhot Creek	54	18.56	0	0.00	92	0	0	0	0	0
Tate Parrish Branch	55	16.68	0	0.00	64	2	0	0	0	0
Telamay H. & Dog Hollow	56	12.37	0	0.00	10	0	0	0	0	0
Terrapin Creek	57	17.44	0	0.00	120	0	0	0	0	0
Tyner Creek	58	42.67	0	0.00	210	3	0	0	0	0
Walltrip Branch	59	9.96	0	0.00	40	3	0	0	0	0
Welling Creek	60	4.98	0	0.00	10	0	0	0	0	0
West Branch	61	7.77	0	0.00	35	3	0	0	0	0
Total Watershed	**T**	**821.69**	**3**	**0.76**	**9,073**	**100**	**0**	**10**	**0**	**1**

Table 26, **Table 27**, **Table 28**, and **Table 29** list the estimated nutrients (Nitrogen and Phosphorus) excreted by confined animals in each watershed or subwatershed. Estimates were derived from numbers provided by Doug Hamilton of OSU Cooperative Extension in Stillwater. A synopsis of these numbers follows:

Broilers/20,000 birds

- 5 flocks/year at 50 days/flock
- Average weight of bird = 2 pounds
- Nitrogen production = 1.10 lbs./1000 lbs. live weight/day
- Phosphorus production = 0.34 lbs./1000 lbs. live weight/day
- Nitrogen excreted by 20,000 bird house/year = 11,000 lbs.
- Phosphorus excreted by 20,000 bird house/year = 3,400 lbs.

Turkeys/20,000 birds

- Occupied 300 days/year
- average weight = 11.75 lbs.
- Nitrogen production = 0.74 lbs./1000 lbs. live weight/day
- Phosphorus production = 0.28 lbs./1000 lbs. live weight/day
- Nitrogen excreted/20,000 bird operation/year = 53,000 lbs.
- Phosphorus excreted/20,000 bird operation/year = 20,000 lbs.

Hogs/600 sow unit

- Nitrogen excreted/600 sow unit/year = 23,000 lbs.
- Phosphorus excreted/600 sow unit/year = 7,600 lbs.

Table 26. Estimated Nutrients Produced by Poultry in Subwatersheds of the Illinois River.

			Broiler				Layer			
			lbs/yr		lbs/mi²/yr		lbs/yr		lbs/mi²/yr	
Subwatershed	**GIS label**	**Size (mi²)**	N	P	N	P	N	P	N	P
Ballard Creek	1	25.19	522500	161500	20745.55	6412.26	8250	2550	327.56	101.25
Battle Branch	2	9.33	22000	6800	2357.81	728.78	0	0	0.00	0.00
Beaver Creek	3	14.51	77000	23800	5307.23	1640.42	0	0	0.00	0.00
Bidding Creek	4	17.46	143000	44200	8191.47	2531.91	0	0	0.00	0.00
Blackfox & Winset Hollow	5	22.92	22000	6800	959.73	296.64	0	0	0.00	0.00
Blue Spring Branch	6	5.28	88000	27200	16656.62	5148.41	16500	5100	3123.12	965.33
Burnt Cabin Creek	7	12.32	0	0	0.00	0.00	0	0	0.00	0.00
Calunchety Hollow	8	6.95	0	0	0.00	0.00	99000	30600	14249.37	4404.35
Cedar Hollow & Tully Hollow	9	11.12	0	0	0.00	0.00	0	0	0.00	0.00
Crazy Creek	10	9.41	77000	23800	8185.97	2530.21	33000	10200	3508.27	1084.38
Dennison Creek	11	7.89	0	0	0.00	0.00	0	0	0.00	0.00
Dripping Spring Branch	12	11.35	88000	27200	7751.58	2395.94	44000	13600	3875.79	1197.97
Dripping Springs Hollow	13	11.76	0	0	0.00	0.00	0	0	0.00	0.00
Dry Creek & Bolin Hollow	14	27.48	33000	10200	1201.00	371.22	0	0	0.00	0.00
Elk Creek	15	21.67	0	0	0.00	0.00	0	0	0.00	0.00
England Hollow Creek	16	9.46	77000	23800	8142.75	2516.85	0	0	0.00	0.00
Evansville Creek	17	48.52	176000	54400	3627.05	1121.09	24750	7650	510.05	157.65
Fagan Creek	18	3.72	66000	20400	17735.81	5481.98	33000	10200	8867.91	2740.99
Fall Branch	19	8.62	0	0	0.00	0.00	33000	10200	3829.42	1183.64
Falls Branch	20	10.93	44000	13600	4025.59	1244.27	0	0	0.00	0.00
Field Hollow	21	6.64	33000	10200	4969.90	1536.15	0	0	0.00	0.00
Five Mile Hollow	22	11.23	0	0	0.00	0.00	22000	6800	1959.67	605.72
Goat Mountain	23	12.60	0	0	0.00	0.00	0	0	0.00	0.00
Green Creek	24	15.60	448250	138550	28728.00	8879.56	0	0	0.00	0.00
Hazelnut Hollow	25	4.52	110000	34000	24312.49	7514.77	5500	1700	1215.62	375.74
Illinois River Echota Bend Laterals	26	6.92	22000	6800	3179.43	982.73	0	0	0.00	0.00
Kirk Springs & Sawmill Hollow	27	9.13	0	0	0.00	0.00	0	0	0.00	0.00
Linder Bend & Sawmill Hollow	28	8.46	0	0	0.00	0.00	0	0	0.00	0.00
Luna Branch	29	14.83	451000	139400	30408.26	9398.92	0	0	0.00	0.00
Mining Camp Hollow (North)	30	6.91	0	0	0.00	0.00	0	0	0.00	0.00
Mining Camp Hollow (South)	31	7.87	0	0	0.00	0.00	0	0	0.00	0.00
Mollyfield & Peavine Creeks	32	12.03	0	0	0.00	0.00	0	0	0.00	0.00
Mulberry Hollow	33	15.96	0	0	0.00	0.00	0	0	0.00	0.00
Negro Jake Hollow	34	16.98	41250	12750	2429.67	750.99	0	0	0.00	0.00
North Briggs Hollow	35	2.11	22000	6800	10406.17	3216.45	0	0	0.00	0.00
Park Hill Branch	36	19.14	0	0	0.00	0.00	0	0	0.00	0.00
Peacheater Creek	37	25.34	313500	96900	12373.04	3824.39	49500	15300	1953.64	603.85
Peavine Branch	38	16.14	110000	34000	6814.57	2106.32	22000	6800	1362.91	421.26
Pettit Creek	39	15.51	0	0	0.00	0.00	0	0	0.00	0.00
Pine Hollow	40	5.12	0	0	0.00	0.00	0	0	0.00	0.00
Proctor Mountain Creek	41	10.03	33000	10200	3289.30	1016.69	0	0	0.00	0.00
Pumpkin Hollow	42	18.66	0	0	0.00	0.00	0	0	0.00	0.00
Ross Branch & Tahlequah Creek	43	18.35	0	0	0.00	0.00	0	0	0.00	0.00
Sager Creek	44	8.24	121000	37400	14691.15	4540.90	0	0	0.00	0.00
Scraper Hollow Creek	45	9.33	74250	22950	7957.80	2459.68	0	0	0.00	0.00
Shell Branch	46	17.58	88000	27200	5004.85	1546.95	8250	2550	469.20	145.03
Sizemore Creek	47	6.99	0	0	0.00	0.00	0	0	0.00	0.00